THE ASTRONOMICAL REGISTER.

THE

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INDEX TO VOLUME IX.

Names of New Subscribers, Instruments for Sale, &c.
Notices to Correspondents, &c., &c.

APPENDIX.

ENGRAVINGS.

The Astronomical Register.

No. 97. JANUARY. 1871.

CONTENTS.

ADDRESS.

THE pressure upon our limited space, from more interesting matter, prevents us from saying much to our kind friends and subscribers; but we cannot pass over the commencement of our Ninth volume without a few words to them.

It has not been without much trouble and anxiety that the *Astronomical Register* has been carried through eight volumes. In fact, had it not been for the determination of its projector to continue the publication of this Journal (while so many other scientific periodicals collapsed), notwithstanding a certain amount of pecuniary loss, the *Register* must have been given up in its first lustrum; for—to take our readers for once so far into our confidence—there was a decided loss upon the first five volumes. We are happy to say that for the last three years the number of our subscribers has slowly but steadily increased, so that now there is a slight profit upon our publication. Even now, however, the original loss of the earlier years is not entirely covered. It is this increase that has enabled us to continue our friendly and pleasant intercourse with our readers.

If our circulation could be considerably enlarged, we should be able to carry out many excellent suggestions which have been frequently made. If we could see our way to do so, we should much like to increase the number of our pages—to give more illustrations, often so necessary to a full understanding of the subjects treated upon.

We take this opportunity of thanking several kind friends for their valuable suggestions, and to assure them that we have not forgotten them. As far as opportunities allow, we shall from time to time carry them into effect. We are glad to say that we still receive, in numerous letters from our correspondents at home and abroad, the most gratifying testimony as to the efficiency and usefulness of the *Register;* and we have every confidence that, with the help of our friends, we shall be enabled to carry it on with renewed vigour and still greater usefulness.

THE ECLIPSE EXPEDITION.

The arrangements having been completed, and the organization effected as well as the short time at the disposal of the Committee allowed, the Spanish party of the observers left Portsmouth in H.M.S. *Urgent*, on the morning of Tuesday, December 6th. The vessel carried out Professor Newcombe, U.S., and Mrs. Newcombe.

The *Cadiz detachment* comprised the Rev. E. J. Perry, in charge of the party, who would himself observe with the Spectroscope; Mr. Mackay, his assistant; Messrs. Moulton, Hudson, and Fizon, for the Polariscope observations; Messrs. Nassel, Smyth, Penrose, and Collins, to sketch the Corona; and Captain Toynbee, to manage the time and general observations.

The *Gibraltar troop*, under the care of Capt. Parsons, R.E. and Lieut. Brown, R.A., included: for the Spectroscope, Messrs. Carpmael and Girdon; for the Polariscope, Messrs. Lewis, Ladd, and Baynes; for the Photography, Mr. Buckingham and assistant; for sketching the Corona, Messrs. Hunter, Harrison, and Anson; and for observing Saturn in the Corona, Messrs. Talmage, Maclear, and Thorpe.

The *Urgent* also carries so far as Gibraltar the party who will there be turned over to a smaller vessel, and conveyed to Oran. This section includes the following very able observers, viz.: Dr. Huggins, Professor Tyndal, the Rev. F. Howlett, Mr. Carpenter (of Greenwich Observatory), Mr. Crookes, Capt. Noble, Admiral Ommaney, and Dr. J. H. Gladstone.

Lord Lindsay and his assistants started some time before the

Expedition, fully equipped for photographing the Eclipse near Cadiz.

The *Sicily department* of the Expedition has necessarily had to proceed overland, on account of the short time at its disposal.

The party left Charing Cross station on the night of Wednesday, December 7th; and we learn from *Nature* that they arrived at Rome safely on the morning of the 12th. The party intended leaving Naples for Syracuse in H.M.S. *Psyche*, in the course of the 14th Dec. The observers are Mr. and Mrs. Lockyer, Professor Roscoe and his assistant, Mr. Bowen, Mr. Seabrooke, Mr. Pedler and Mr. Barton, for the Spectroscope; Mr. Ranyard, Mr. Griffiths, Mr. Clifford, Mr. Adams and Mr. Harris, for the Polariscope; Messrs. Brett and Darwin, for Sketching; Mr. Brothers, Herr Vozel and Mr. Fryer, for Photography; Mr. Vignolles and Mr. Vignolles, jun., for time and general observations; and Professor Thorpe, for Chemical Intensity. Some of the American Expedition also observe in Sicily.

The *Psyche* started from Naples as proposed, but, unfortunately, on her way to her destination, she struck on a rock off Catania. The passengers and philosophical instruments were all saved; and so, we trust, the Expedition will still accomplish the object proposed.

The list of the University of Oxford appointed to the English Eclipse Expedition is—for the Polariscope: Messrs. G. B. Lewis, of Oriel; R. Abbay, of Wadham; F. W. Fizon, of Christchurch; E. Baynes, of Wadham:—Sketching the Corona, Messrs. F. H. Browne, of Wadham; E. G. Harrison, of Merton; F. H. Anson, of Baliol.

At the time of writing this, nothing more is known of the movements of the Expedition; and we can only wish all parties the success they deserve, and express a hope that Science may be a gainer by their labours, and that the vexed question of the nature of the Corona will be settled on this occasion.

THE ECLIPSE OF THE SUN, DECEMBER 22.

The heavy snow-clouds shrouding the sky seemed, during the earlier hours of the morning, to preclude the possibility of getting even a glimpse of the sun. All hope of observing any of the phenomena appeared quite hopeless as the time of the Eclipse drew on, at any rate in our neighbourhood; but, a little before noon, breaks in the clouds gave a passing view of the sun, enabling even those who were not prepared with dark glasses to have a fair sight of the Eclipse. After noon the sky cleared round and behind the sun, so that the end of the Eclipse was perfectly seen. The beautiful blue of the sky, at the period of greatest obscuration, was very striking. Upon the sun's disk there were several small spots, and one magnificent double spot connected by numerous smaller ones. The emersion of this fine object from the dark body of the moon was a beautiful sight. A bridge of exceedingly bright light across the larger spot was very noticeable. This spot occupied 13½ seconds in completely passing a wire in the telescope. The instrument used was a portable one by Thos. Cooke, of 2¾-in. aperture. The continual passage of clouds prevented the use of eye-pieces of high power, and so nothing particular was noticed upon the edge of the moon.

We have received the following from Mr. J. Gilby, of Beverley:—

The sun was visible from the commencement of the Eclipse until 5 minutes past 12 o'clock, when it became obscured and remained so till 20 minutes before 1, thus preventing me from seeing the greatest obscuration.

I have nothing to note except a curious spot, or rather two with a connecting line between them, on the NW. side of the sun. They seemed to undergo some little alteration during the Eclipse.

The following, from Lord Lindsay's Expedition, appears in the *Standard*:—

Puerto, Dec. 22, 1.5 p.m.

Photographs successful; two good pictures of corona. Polariscope doubtful. Sketching good. Spectrum no lines; broken sky.

The rest of the telegram is unintelligible.

I am your obedient servant,

41, Parliament Street, Dec. 24. J. S. BERGHEIM.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Second Meeting, December 9, 1870.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries (pro tem.)—T. W. Burr, Esq., and E. Dunkin, Esq.

The Minutes of the last meeting were read and confirmed.

Thirty-five presents were announced, including the 4th volume of the Catalogue of Scientific Papers compiled by the Royal Society, and the thanks of the meeting given to the respective donors.

H. Barnes, Esq., was balloted for and duly elected a Fellow of the Society.

The following papers were read:—

Observations of Coggia's Comet: by Mr. Joynson.

This paper contained a series of places of the comet on the nights of October 1st to 4th. On October 2nd the nucleus appeared to pass over or nearly over an 8th magnitude star, and when nearest, the star, small as it was, entirely put out the light of the comet, which was not visible again till they were distinctly separated.

Occultation of δ^3 Tauri: by Mr. Joynson.

On November 9, 1870, the moon passed over this star. The disappearance took place at 11h. 19m. 11·3s. G.M.T., and the reappearance at 12h. 16m. 50·7s. G.M.T. The observations were considered very satisfactory.

Note on the Proper Motion of Oeltzen's Argelander 17415–6: by Mr. Lynn.

This is a small 9th magnitude star found in Argelander's zones and inserted in Oeltzen's Catalogue, made from them under the above numbers. It was placed on the Greenwich Working List, but unfortunately with a wrong N.P.D., so that the observations made were not of Argelander's star. In August 1870 this error was found out, and the proper star has since been observed with the Greenwich Transit Circle. These observations were given in a table. The proper motion is considerable, amounting to 0·07s. R.A. and $1''\cdot 2$ N.P.D.

On the Proper Motion of 36 (A) *Ophiuchi and* 30 *Scorpii*: by Mr. Lynn.

The well-known double star 36 Ophiuchi is about 13′ from the 7th magnitude star 30 Scorpii, and they both have a proper motion of considerable amount in the same direction. The binary star has a period of about 200 years. Tables of observations of the above stars were given; and the identity of motion may be seen from quoting the result in N.P.D., which is respectively $1''\cdot 0$, $1''\cdot 05$, and $1''\cdot 17$.

On the Graphical Construction of a Solar Eclipse: by Prof. Cayley.

This paper was explained and illustrated with diagrams by the author. The design is to construct with a stereographic projection, and by aid of a scale of parts prepared for the purpose, a figure like those in the Nautical Almanack. The example shown was that of the coming Eclipse; and the author found that his construction agreed with calculation within 1·5m. of time, and 1° of latitude and longitude; but he thought, with greater care, these variations could be reduced to 0·5m. of time, and 0·5° of geographical position.

Mr. Browning exhibited and described his latest improved form of the Automatic Spectroscope, and illustrated the construction by a movable diagram. He said that it might have been thought complete before, but he did not like the cam motion; and Mr. Proctor, looking into the necessary conditions, found it might be dispensed with by adding another bar at half the angle of the others; and thus keeping the face of the telescope always opposite to the face of the first prism. Mr. Proctor had also made another valuable suggestion, and he (Mr. B.) wished to acknowledge his great indebtedness to that gentleman for having pointed out such a simple method of completing the contrivance.

The papers being exhausted, the President invited observations or communications on any other matters of interest.

Mr. W. Simms said that, at the instance of Mr. Carrington, he would mention an observation which he should otherwise not have done. On October 11th he was trying a 2¾-inch telescope on α Lyræ, and saw a small star near, which, thinking it was the known companion, made him imagine he had got a first-rate glass. However, the position did not suit for that, and on the next night he found it in another position. It then occurred to him that it might be an asteroid; but on communicating with Mr. Lynn and Dr. Peters, they said it was not any of the known ones; and, on account of the great latitude, although it was possible, it was not probable that one should be there. It was known that there were many small stars about that part. The weather had not allowed any further observations.

The President: Then we may understand you have seen 2 stars near α Lyræ—the recognised companion and another?

Dr. De la Rue: What was the power?

Mr. Simms: About 120. The distance was about 30″.

The President drew a diagram of the group.

Mr. Simms: On the first night I saw the star higher and afterwards lower. The recognised companion I saw with a larger telescope.

Dr. De la Rue: Did you rotate the eye-piece?

Mr. Simms: Yes; it made no difference.

The President: It may be a variable star, but it is not very likely. I should recommend you to pursue the subject with the same telescope. Did other objects lead you to the conclusion that it was a particularly fine one?

Mr. Simms: No.

Mr. Lynn: I informed Mr. Hind of the observations made by Mr. Simms. Mr. H. made a good search in the neighbourhood, but found no moving body.

Dr. De la Rue said that as the minds of all were full of the *Eclipse*, which also caused the absence of so many friends, he would make a few remarks upon the subject of the nature of the Corona, which was the most important point the Expedition had to clear up. The Corona consisted of two parts—one very near the sun, and undoubtedly belonging to it; the other extending far away from the dark moon, sometimes as much as 15′, and throwing out very curious rays and projections. It was extremely difficult to account for these. Mr. Lockyer had brought forward a theory that the Corona was an effect in our atmosphere; and Mr. Seabrook had written a paper to support him, and show that a portion of atmosphere within the cone of the shadow might be illuminated from without. The speaker's opinion was that part of the light might be produced in this way; but his principal object was to introduce a German paper, by *Oudemans*, to the notice of the meeting. This author supposed that, besides meteors and planets, our system is full of an immense number of fine particles moving in space round some centre, and which may be illuminated by the sun, and by parallax reflect light to us when the direct sunlight is cut off; and thus form a regular halo round the moon. The irregularities of the moon's edge would account for the projecting rays; and, if changes occur in these during the Eclipse, the moon's change of position equally accounts for the alterations.

Mr. Carrington: Oh! oh!

Dr. De la Rue thought the theory as good as any other at present.

Mr. Gibbs: Mr. Grove thinks that there is no such thing as the ether usually supposed to fill space. We should rather imagine some diffuse matter between the sun and moon, not definite particles. Something like the vapours in Dr. Tyndall's tube experiments, which are not one-millionth part of the weight of the surrounding air.

Dr. De la Rue: But still they are definite particles of matter, or the clouds would not be visible.

The President: Why, if space is full of these fine particles, do we not see light all over the sky at eclipses?

Mr. Dunkin: I am certainly somewhat impressed by Oudemans' paper, but it is a difficulty why the light should not be seen further. I have witnessed an eclipse, and think the Corona is something near either sun or moon.

Dr. De la Rue: It is probably near the moon.

Professor Selwyn: Why should a similar light not be seen when the moon is nearly new?

Dr. De la Rue: The sun and moon are not then in the same position as at an eclipse.

Professor Selwyn: They are very nearly so, and the light of the young moon is so very faint that it ought not to put out this illuminated matter.

Dr. De la Rue: The moon would not be less than two days old for us to see it at all, and then the circumstances are very different. During an eclipse the sun is intensely bright while the moon acts as a screen in front of us; but in the other case, the sun is lower, or actually below the horizon. If you draw the positions you will see that, under these circumstances, the particles could not reflect any light to the earth. At an eclipse they are in the direct line from the sun to the earth.

Professor Selwyn: I should think the case I put more favourable than the other.

Mr. Lynn: I doubt if sufficient notice has been taken of a theory of Mr. Baxendell, connecting meteors and magnetic currents. As to the existence of a great number of meteors, it is corroborated by many phenomena.

The President: I have not seen his paper.

Mr. Lynn: The theory requires that the Corona should be elliptical; but though it is generally described as circular, there have been records of an elliptical shape.

Mr. Carrington: I do not think this shape has been seen.

Mr. Browning: At an eclipse in Chili it was so described.

Mr. Lynn: Some ellipses are nearly circular. Meteors may have short elliptical orbits as well as long.

Dr. Draper, of the United States, at the request of the Chairman, gave an account of a large *Telescope* recently constructed by his son, Dr. Henry Draper. It was a silvered-glass reflector of 28 inches aperture, on the Cassegrain plan, and of 13 feet focal length. The mounting was that of the German form of equatorial, under a dome 21 feet in diameter, and which, being mounted on a system of friction rollers, could be turned with two or three fingers. The tube was not solid, but consisted of a light wooden framework. So far as the trials in the workshop showed its character, it appeared to approximate to perfection. He had another telescope of 16 inches aperture, with which the moon had been photographed very successfully. In the new telescope the primary image of sun or moon would be six inches in diameter. Silvered-glass mirrors seemed to work better in America than in England. The 16-inch one was, after five or six years' use, as bright as ever. Possibly it was because when not in action the mirrors were covered up by a glass plate, resting on the edge, ground flat for the purpose. The glass of the great mirror is only about 1½ inch thick, and the silvering was done by the Rochelle salt process. The difficulty of supporting mirrors so as to avoid flexure is very great. Blankets were tried first and failed, but an India-rubber air bag seemed to succeed. Dr. Draper had made about 200 mirrors of different sizes. They were tested during completion by Foucault's method. There was a curious result with some. When looked at in the direct axis they acted badly, but if tilted a few inches, as in the Herschelian view, they gave brilliant definition. With the 28-inch mirror a star showed a circle of light out of focus either way, and a dot with very little irradiation when in focus. The telescope will be erected and worked at Hastings, 20 miles north of New York.

Mr. Browning: I think the secret of keeping silvered-glass mirrors in good order is to let them alone, which no one here does. They are too fond of wiping them with dirty rags. I have one which came from Paris seven years ago and is as good as ever. My mirrors do not get dirty.

Dr. Draper: Mr. Rutherford, who lives in New York, is not so successful with his mirrors as we are. I think the sulphur in the gas of the city acts upon the silver. Damp is our great enemy, it splits up the silver from the glass.

Mr. Browning: All organic matter injures them. Many persons cover them with a piece of black velvet, which is a bad thing. I do not find wet hurts mirrors.

The President: No substance should touch them.

Dr. De la Rue: My experience differs from that of Mr. Browning. I had a mirror which kept bright for three years, but one day it got wet and the whole surface broke up. In another case the silvering of a solar eye-piece got spoilt. I find that silvered glass is not nearly so good as metallic mirrors. I have one 16 years old as good as ever.

Mr. Browning: In the case of Dr. De la Rue, he has not the anxiety of most people as to repolishing, having the means of doing it himself; but if you have to send a metal mirror to the optician, it may cost as much as it is worth, while a silvered glass can have a fresh coating deposited for a trifle. For the majority they are certainly the best.

The President: If a metal mirror be good originally, it is practicably indestructible.

Dr. De la Rue: I should have imagined, from the lightness of glass, that the flexure, when set on end, would not have been troublesome.

Dr. Draper: If you set a glass mirror in certain positions, it may appear optically perfect, but if turned round may be very bad. Many have been thrown aside on this account, which, if moved, might have done well. The glass is made by rolling, and gets a structure, which, when it stands one way, makes it better than in another. The best figure, we find, is given by hand, and not by machinery. The latter always produces a sort of pattern. The polisher must have a series of circles on it within one another. These break up the surface, and allow the air to circulate.

Mr. Lecky enquired whether the glass rested on the same bed, and was in its cell when polishing, as in the telescope?

Dr. Draper: It rests on an india-rubber bag with a hole in the centre, and has a rubber band round it. The excellence of the support is shown by there being practically no difference whether you look at a star in the zenith, or near the horizon. The glass mirror weighs 70 lbs.

The President: And Lord Rosse's $3\frac{1}{2}$ tons!

The meeting then adjourned.

Erratum in last Report: for *Captain* read *Colonel* Drayson.

CHANGES IN OUR ASTRAL HEAVENS.

α COLUMBÆ.—Is rising in the sky, and will continue to do so for 700 years more, when its greatest meridian altitude at London will be $4\frac{1}{2}$°, only slightly more than the present $4\frac{1}{3}$°. In 3,900 years it will cease to be visible.

FROMALHAUT.—First appeared above the horizon of London 1,700 years ago. In long. 90°, 8,400 years hence, it will attain its greatest meridian altitude, nearly 41°, and then begin to descend.

λ SCORPII; with υ called *Shaulah*, the sting. One of the lowest objects in our sky; meridian altitude, $1\frac{1}{2}$°. It is getting lower still, but can never disappear, its lat. being $13\frac{3}{4}$°, though 500 years from this its meridian altitude will be $\frac{1}{4}$° less than at present; after which, in half the revolution of the equinoxes, or above 12,000 years, it will attain a meridian altitude of 48°, when of course the whole constellation of the Scorpion will be in the mid-heaven higher than Orion is now.

α LYRÆ, Wega; long. 283° 29′, lat. 61° 44′ N. Its meridian altitude at present is 77° 11′, but in 4,900 years hence, its long. being $352\frac{1}{4}$°, its declin. will be 51° 29′; so that it will be in the zenith of London.

α CYGNI. *Dheneb-al-dajdjeh*, the hen's tail; long. 333° 32′, lat. 59° 55′ Its meridian altitude at present is 83° 20′. In 1,700 years hence, in long. $356\frac{3}{4}$°, it will be in the zenith of London.

α AURIGÆ.—Though the meridian altitude of Capella is $84\frac{1}{3}$°, it can never reach the zenith, as its long. is about 80°; so that it has only something more than 700 years to rise, which will increase its meridian altitude only about $\frac{1}{3}$°, and leave it still 5° from the zenith.

α PERSEI. *Mirfak* ("the elbow"), or *Algenib* (*jeub*, "the side"); long. 60° 16′, lat. 30° 7′ N. Would be in the zenith of London in 660 years, in long. $69\frac{1}{2}$°. But allowing for the decrease of the obliquity of the ecliptic, the time is found to be 690 years, and its long. 69° 50′. It is now, when on the meridian, 2° 5′ below the zenith,

γ DRACONIS. *Etamin*, for *Rás-al-tannin*, "the Dragon's head." This famous star, only 1′ 40″ from the zenith, at the present rate of annual decrease of declination 0″·6, would be in the zenith in 167 years.

α CENTAURI; long. 237° 53°, lat. 42° 32′ S. Estimated by the globe, this fine star was still visible at the lat. of Greenwich when its long. was 181°, more accurately by calculation $180\frac{1}{2}$°; this was therefore 4,100 years before the present time, or B.C. 2,200 (epoch of Tower of Babel, common chronology). Previously to this it may have attained a meridian altitude of $38° 31' + 23° 27' - 42° 32' = 19° 26'$ and $237° 53' - 90° = 147° 53'$, which at the average rate of precession would take 10,600 years to accomplish, so that B.C. 8,700 α Centauri had a meridian altitude of 19⅓°. Estimating by globe, it will begin to be again visible at the lat. of Greenwich when its long. is 2°, or by calculation ⅓°, which would be 8,900 years from the present time.

α CRUCIS; long. 220°, lat. 52°53′ S. In long. 153°, 4,900 years ago, or B.C. 3,100, it was still visible at the lat. of Greenwich; and, being the lowest bright star in the Southern Cross, the whole constellation was then above the horizon. 9,300 years ago, or B.C. 7,400, its meridian altitude was 9°. It will not be again visible at the lat. of Greenwich till its long. is about 149°, or for 20,700 years.

CANOPUS. *Soheil*, α Argus; long. 193° 10′, lat. 75° 51′ S. When Canopus (Canobas) was in long. 180° it made its nearest approach to the horizon of London, above which of course it can never appear. This was 900 years ago, when it was 75° 51′ − 38° 31′ − 23° 27′ = 13° 52′ below the horizon.

α ERIDANI; long. 343° 8′, lat. 59° 21′ S. Achernar (*Akher-nahr*, the end of the river) will become visible in long. 55°, at the lat. of London, 5,100 years hence; and 2,500 years after that it will attain its greatest meridian altitude, 2⅛°.

The following will always be visible at London:—Upper part of head of Lupus and one of his fore legs; upper part of Corona Australis; all Saggitarius except the legs; a very little of the upper part of Piscis Australis; all Aquarius except a foot; most of the head, and a little of the back and tail of Cetus; head of Orion; part of head and neck of Monoceros; upper half of Canis Minor; head, neck, and tail of Hydra; upper part of Crater; wings and tail of Corvus; all of Scorpio except the curved part of its tail. Part of Argo Nabis can never be visible.

Proper Motions.—Whilst, as evident by the above illustrations, precession has materially changed and will change the aspect of the heavens in the course of many ages, these changes are only temporary, and come round in the known cycle of 25,868 years, and they do not affect the relative positions of the stars, whereas proper motions in vast periods of time would cause the permanent disruption of the present configurations of the stars, at least to a great extent. Humboldt observes,* "The Southern Cross will not always shine in the heavens in the same form which that constellation now presents, as the four stars of which it is composed move with unequal velocities in different paths. How many thousand years may be required for the entire dissolution of the constellation, is not to be calculated. As marked instances, the proper motion of Arcturus in 2,000 years is 1¼°; that of Sirius, ¾°; of Procyon, 43′; μ Cassiopeiæ and 61 Cygni make 1⅔° in 1,000 years. The star 1830 Groombridge of 5·6 magnitude in Ursa Major has a motion of about 2° 8′ in 1,000 years. Humboldt observes, "At the end of 3,000 years, about 20 stars will have altered their place 1° and upwards. It was remarked by Trontenelli, "There is a star in the Eagle (α) which, if all things continue their present course, will, after the lapse of a great number of ages, have to the west another star which at present appears to the east of it." † If ξ is meant by this star, the proper motion of Altair would cause both to have the same R. A. 5,800 years hence (assuming ξ to have no motion); after which Altair would have ξ to the west of it.

The stars α, β, γ Aquilæ are getting further and further from being in a line with each other. This arises from the large proper motion of α, both in R.A. and Decl., and a large proper motion of β in Decl. of the contrary sign to α. Some time ago therefore, when α had less R.A. and Decl. than at

* *Cosmos*, iii. p. 179. † Chambers' *Descriptive Astronomy*, p. 493.

present, and β was slightly less in R.A. and further north, these stars must have been exactly in a straight line (α is now about 9′ out of the line joining β and γ). Taking the data from the Radcliffe Catalogue, it would appear as the result of a graphical process that this was the case 700 years (approximately) ago. On the other hand, the stars of the belt of Orion have a tendency to get into a straight line. ϵ is at present about 5′ perpendicular distance below the line joining δ and ζ. Taking the motions for ζ from Speculum Harbrœllianum, and for the other two from the Radcliffe Catalogue, ζ is decreasing in R.A. and, as well as δ, decreasing in Decl. This evidently would ultimately bring them all on a line, and by trials graphically it would do so in about 9,000 years hence. This conclusion, however, must be taken with reserve, for the proper motions of δ and ζ are very small, and ϵ is assumed to have none; small corrections therefore in those data might greatly affect the numerical result.

From the recent very remarkable spectroscopic observations of Mr. Huggins, Sirius appears to be moving from us at the rate of 29·4 miles a second. We might at first be disposed to think that such a meteor-like velocity would, even after a moderate interval of time, produce some apparent effect on the parallax and brightness of the star; an idea, nevertheless, dispelled by a few figures. 29·4 miles a second is about 2½ millions (2,540,160 miles) in 24 hours. Dividing the Sun's distance, 91,430,000, by this, we have 36 days for the time in which Sirius passes over the Sun's distance from the earth. But Sirius, taking its parallax at 0″·15, is 1,375,100 times the Sun's distance from the earth. Supposing its motion to continue as at present till its parallax becomes 0″·10, this would give a distance of 2,062,650 times the Sun's distance from the earth; that is, an increase of distance one-half, or 687,550 times the Sun's distance, more than at present. By proportion this would be passed over in 67,767 years; the time required for the parallax of Sirius, moving as fast as assumed above, to be lessened only the 20th part of a second. The effect of this increased distance on its brightness will be found thus: Sirius, according to Sir John Herschel, is now four times as bright as α Centauri. Diminishing this in the inverse ratio of the square of the distance, if Sirius were removed to twice its actual distance it would still be as bright as α Centauri; and for a distance half as much more than the present, the proportion $(1·5)^2 : 1 :: 4 : 1·78$ shows that after moving at its present rate for nearly 68,000 years, Sirius would still be 1¾ times brighter than α Centauri.

Other changes in the heavens may be thus enumerated. Stars which have disappeared; new and temporary stars; variable stars: under which head some think the two preceding classes may finally be included. And if changes discernible only by the telescope are to be taken into account, some variable nebulæ, and the revolution of double and multiple stars round a common centre of gravity, have to be mentioned. Finally, there is the change of colour in certain stars, which in a few instances appears to be established: such as γ Leonis and γ Delphini, and Sirius, which Seneca describes as "redder than Mars," and which is classed as to colour by Ptolemy with Arcturus and Betelgeuza. (See Chambers' *Descriptive Astron.* p. 483; Smyth's *Cycle*, Vol. 1, p. 303; Humboldt's *Cosmos*, Vol. 3, pp. 112–114, 453.) Humboldt thought it probable that the change of colour of Sirius took place intermediately between the epoch of Ptolemy and that of the Arabian astronomers. (*Cosmos*, Vol. 3, p. 454.)

GEORGE F. WALKER.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

AURORÆ AND STORMS OF WIND.

Sir,—The assertion that Auroræ are "invariably" the forerunners of great gales should not, perhaps, be allowed to pass unchallenged. That this is the popular belief wherever the Northern Daybreak is frequently seen, is well known; and it might with safety be added that popular belief also connects these two grand sequences of phenomena, regarding the case as one of cause and effect. It is almost needless to remark that, even were Auroræ invariably followed by terrific storms, it would not therefore follow that one is the cause of the other, any more than that night is the cause of day because it has always succeeded day. Sir John Herschel says: "So far as has hitherto been proved, there is no meteorological effect either as regards temperature, moisture, barometric pressure, or wind, which is in the smallest perceptible degree influenced by its most vivid displays." And as regards the empirical law so widely believed, the following words of Kaenitz may be given: "Brilliant Auroræ which dart much into rays are frequently the precursors of gusts of wind, and of an abnormal distribution of heat over the surface of the globe."

However, as the late magnificent displays of the glories of the northern sky have given a fresh interest to all the suspected and known relations of the phenomenon—periodicity, sun-spot maximum, disturbance of the magnetic needles, &c.—the following extracts from my Meteorological Journal will perhaps be acceptable to many of your readers:—

Year	Date	Character of display	Weather a few days		Remarks
			Preceding	Following	
1865	Oct. 18	Fine	Calm, wet	Wind, hail, snow	[on 27th
	„ 26	Fine	High winds	Cloudy, high winds	Gale on S.E. coast
1866	Feb. 21	Very fine	Frost, snow	Wet, hail	High wind on 23rd
	„ 25	Bright	Thaw, snow	Windy	
	Aug. 19	Faint	16th wet, windy; 18th fine	Cloudy	11th Sept. high wind
	Nov. 9	Faint	High winds	Windy	11th Nov. high wind
1867	Sept. 22	Bright	Cloudy	Gale on 23rd	
	„ 24	Faint	Cloudy	Cloudy	
	Oct. 2	Faint	Gale	Cold	Gale on 26th
1868	„ 19	Bright	Rainy	Cold	
	„ 21	Bright	Rainy	Cold	Gale on Nov. 1st
1869	March 2	Bright	Snow, hail; rapid fall of barometer	Snow, hail, rain	Windy on 5th
	May 13	Fine	Fine	Cloudy	
	Oct. 6	Fine	Cloudy	Rain	
1870	Jan. 3	Bright	Wind, rain	Showery	
	May 4	Faint	Thunder, snow, hail	Fine	
	Aug. 20	Bright	Fine	Cloudy	
	Sept. 3		Cloudy	Showery	Gale on 10th
	„ 24 „ 25	Fine	Fine	Fine	
	Oct. 14 „ 15	Fine	Wet	Wind, snow, rain	High wind on 17th
	„ 20		.. ..	Wet	
	„ 24 „ 25	Fine	.. ..	Rain, hail, thunder	Rain, hail, thunder

From these it will be seen that storms often precede the Aurora, that it seems to form part and parcel of a vast disturbance in earth and air and sky, or that it is one link in a splendid phenomenal chain. Perhaps the day is not far distant when we shall not only discover many other intermediate links, but even rise to the high discovery of a chain of causation.

Yours truly,
JOSEPH GLEDHILL.

SOLAR EYE-PIECES.

Sir,—I send a description of a set of solar eye-pieces, which I am now making for my 3-inch achromatic. Two are completed; the lenses I have ground myself.

These eye-pieces are of the ordinary Huyghenian form, but the two lenses are made of glass of two complementary colours, in order to produce a white image. The colours which I have preferred (after many experiments) are, a yellowish neutral tinted glass for the field-lens, and a blue glass for the eye-lens. This combination produces a clear white image, and as the eye-piece consists of two lenses only, all *additional* apparatus, such as screens, prisms, &c., is completely got rid of. There is no glare or haze in the field of view caused by the reflection of the solar rays by the interior surfaces of the lenses, and the definition is consequently hard and sharp. When the atmosphere is sufficiently tranquil, one of these eye-pieces, magnifying about 120 diameters, shows a faint interference line just outside the Sun's limb. I mount these lenses rather loosely in their cells, to allow for the expansion of the glass by the Sun's rays.

I notice that the nucleus of the large spot now traversing the Sun's disc is covered by a sort of gauzy veil, except an oval aperture nearly in the middle, which is very black. Round the border of this black hole the gauzy film is apparently deeper, and looks brighter, having the appearance of a nebulous ring. In moments of better definition (the atmospheric definition has been very bad lately) this nebulous ring appears granular or curdled.

I am, Sir.
Yours truly,
WILLIAM ANDREWS.

Gosford Green, Coventry:
Nov. 19, 1870.

JUPITER.

A general description of the principal features now to be seen during one rotation of this planet will probably be interesting to many and useful to some of the amateur readers of the *Register*. A glance at the disc at any given time will, with this assistance, enable those who cannot outwatch a long winter night to know what features will soon present themselves, and also to compute the time at which the most striking will appear.

Beginning with the fine southern band No. 6 (see *Register* for April 1870), it may be noted that this is the seat of great activity at present. One portion is but faintly seen, while the other is a broad band, containing two large bright spots. One of these lies close to the W. end of a short dark portion of the band; then for $4''+$ to the E. the band is brighter; at the E. end of this brighter part is the other bright circular spot, followed by a second dark patch. Again, band 5 is connected with band 6 by a broad dark line under the first-mentioned dark portion of 6; and a very little to the E. of this a narrower dark line connects 5 with 4. No. 5 is now seen to join No. 4 a little to the W. of this point. About three hours after this group has passed the central line, a dark square cloud-like form is seen on No. 5: it is connected with No. 6 by a narrow dark line. Two large roughly-circular bright spaces may now be seen to the south-east of No. 6, which is now scarcely visible on the E.

No. 5, which is faint before the two bright spots in 6 appear, afterwards becomes the most striking band on the disc.

No. 2, hitherto the darkest and broadest band on the planet, is now showing signs of change. Dark projections may now be seen on its N. and S. edges: it is very broad but not dark in one part, and dark but not very broad in the other part of the sphere.

When the square form is seen on No. 5, one of these dark projections may be seen on the S. edge of 2, not far from the E. edge of the disc. The festoons in the central zone are seen almost always, when the definition is good.*

JOSEPH GLEDHILL, F.G.S., F.M.S.

Mr. E. Crossley's Observatory,
Park Road, Halifax.

ON A PHOTOGRAPH OF JUPITER.

By Mr. John Browning.

[Read at the November Meeting of the Royal Astronomical Society.]

On the evenings of the 24th and 25th of October, which will be remembered for the magnificent display of the Aurora Borealis, the air being steadier than usual, I made two careful drawings of the planet Jupiter. As these were made on successive evenings, the first on October 24th at 11 P.M., and the second on the 25th at 10.45 P.M., the drawings represent nearly the whole surface of the planet. The equatorial belt is of a fuller ochreish or tawny colour than when I last observed it during the previous apparition. A bright belt to the north of the equator is much the brightest portion of the planet's disc. The dark belts on the northern side were of a very dark brown, with less copper colour in them than I found during my previous observations. The portion of the disc to the south of the equator was peculiarly free from belts. This refers especially to the view obtained on the 24th. The hemisphere seen on the 25th had a bright and a dark belt about midway between the south pole and the equator, tolerably prominent. The ochreish belt was mottled all over the surface with white cloudy markings, or patches—a distinct line of them, though separated by darker markings between, evidently encircled the whole of the planet, a little way to the south of the true equator.

I began a series of very careful micrometric measurements of the relative measures of Jupiter, to endeavour to determine whether any change had taken place in the proportions of the polar and equatorial diameters, but owing to the very unfavorable state of the weather, I have not been able to complete these measurements.

Since writing the above, Lord Lindsay has shown me two photographic negatives of Jupiter, taken in Mr. De la Rue's observatory, within a quarter

* For the time, the dark square form on No. 5 was central at 11h. 55m. P.M. on the 16th of November. The eastern bright spot on No. 6 was central about 9 P.M. on the same night.

of an hour of the time I made my first drawing. It is worthy of remark, that the equatorial belt in these negatives is almost absolutely transparent: the light from this orange-coloured belt has failed entirely to act on the sensitive collodion surface. I have seen negatives of Jupiter taken during previous years in which this equatorial belt had exerted the most action on the surface, giving the belt as quite opaque. I have appended a rough diagram of this negative to my paper.

It seems to me probable that a careful examination of photographic negatives of Mars might throw some light on the disputed question of the colour of the darker portions of the planet. We have evidently not yet exhausted the application of photography to the cause of astronomical research.

THE MOON.

Sir,—From time to time the Moon controversy crops up in your columns, showing that the confusion on the subject is as great as ever. Now it is a great scandal to Astronomy that this question should thus linger on unsettled year after year. Many months ago I addressed you on the subject, maintaining that both sides were partially right—right as regards their own views, and wrong in denying their opponents'. The whole affair is simply this, that it depends upon what point the motion is referred to. If the motion be referred to the axis of the earth, then undoubtedly it is one of simple rotation round the earth, and therefore the Moon does not rotate on her axis; but if the motion be referred to the axis of the Moon, then the Moon does rotate on her axis, and this axis has a motion of translation round the earth. It will be asked, doubtless, why should Astronomers prefer the second mode of considering the motion rather than the first? I answer, because of the facility of computation, and because they desire to consider the motion of the Moon as they do the motion of other heavenly bodies. In the exceptional case of the Moon it might perhaps be simpler to refer the motion to the earth's axis, but if we attempted so to refer the motions of the planets, we should get into inextricable confusion. To all who are interested in this question, I would recommend the study of that chapter in Routh's *Rigid Dynamics* entitled "The Geometry of the Motion of a Rigid Body." I am, Sir, your obedient servant,

London: Dec. 12th. W. B. GIBBS.

METEOR.

Sir,—This evening (Sunday), while I was watching the stars, I noticed a remarkably fine meteor of an intense gold colour. It started from very near the star γ in Taurus, and travelled towards δ in Eridanus. It was larger even than Jupiter, and, the Moon shining with great splendour, I was astonished to see it so very brilliant. The time I observed it was near 6.15. As a subscriber to the *Register*, I have thought that this might interest some of our readers.

Believe me, Sir, yours truly,

14 Manilla Crescent, H. COX.

Weston-super-Mare: Dec. 4.

PUBLICATIONS OF THE ASTRONOMICAL SOCIETY.

Sir,—At the end of your report of the Meeting of the R. A. S., page 268 in the December number, I regret to see repeated the old story, *i.e.* "The Index to the first 29 vols. of the publications of the Society was completed, and would be distributed gratuitously to all Fellows applying for it, *but could not be sent by post.*"

This is saying: "We give to all," but in reality only giving to those Fellows resident in London or neighbourhood, for it is not even said that those who apply through a friend living in London will get copies.

Why not send it by post to all Fellows who would pay the postage, if it be too bulky to send post free?

This is surely not asking too much; if not heavy, the Index should be sent free, as the Society is now prosperous.

Sincerely yours,
J. M. S.

NEW COMET.

To the Editor of the *Times.*

Sir,—On the morning of the 24th Dec. Dr. Winnecke, of Carlsruhe, discovered a comet near the star Gamma Virginis, of which he has forwarded to me the following elements, calculated upon the first three mornings' observations:—

"Perihelion passage, dec. 19·836 Berlin mean time; longitude of perihelion, 9 deg. 26 min.; longitude ascending node, 94·15; inclination to ecliptic, 30·15; logarithm of perihelion distance, 9·63244; helio-centric motion, retrograde."

From these elements the subjoined places are computed; they apply to 18h. Berlin time:—

	R.A. ° ′	N.P.D. ° ′	Logarithm of distance from earth.
Nov. 29	221 26 ...	95 34 ...	9·6051
Dec. 1	234 36 ...	96 11 ...	9·6024
„ 3	247 20 ...	96 36 ...	9·6231
„ 5	258 27 ...	96 51 ...	9·6623

Dr. Winnecke remarks that the comet may become rather bright at its appearance in the evening.

I am, Sir, your most obedient servant,
J. R. HIND.

Mr. Bishop's Observatory, Twickenham.

Star Catalogue.—R. C. J. will find in the 3rd vol. of the *Astronomical Register*, p. 180 (1865), a notice of Ch. Dien's *Celestial Atlas* (Paris), with stars to the 9th magn. The Berlin Zones, in 24 charts, also go to the 9th magn. The *Atlas of Northern Stars*, made at the Bonn Observatory, is to 9½ magn. For catalogues, there is E. J. Cooper's, 60,000 ecliptic stars; Argelander's, 105,000 between +20° and +40°, and 108,000 stars between +41° and +90°; and Bessel's, from −15° to +15° 31,000 stars, and +15° to +45° 31,000 stars; others are given in Chambers' *Descriptive Astronomy.*—G. J. W.

Future Eclipses.—I believe the next very large eclipse of the Sun will be on April 17, 1912. In a list of eclipses I have by me I have seen the size of it stated at 11½ digits. From a careful computation by Ferguson's tables, I cannot make it more than 7¾ digits. Will any of your readers kindly enlighten me on this point? Also, over what part of the United States the shadow of the total eclipse of July 29, 1878, will pass?—Astronomicus.

Brilliant Meteor.—Mr N. E. Green, of St. John's Wood, has forwarded us the following for publication. We have sent the original letter to Mr. A. S. Herschel.—"Towards the end of my late voyage from Australia in the *Superb*, when in lat. 48° N. long. 8°30′ W., bar. 29·76, ther. 60°, at about 9.45 p.m. October 18, I observed a brilliant meteor traversing the sky, from eastward, westward in the direction of the Milky Way. Its luminous tail was perceptibly divided in its entire length by a clear space, through which the stars could be seen. This divided tail, which had the appearance of a luminous vapour, remained clearly visible and defined from 10 to 15 minutes. At first it was straight, but it gradually became bent and serrated, and then slowly recurved itself, as if acted on by the prevailing wind, which was blowing moderately from westward, until it assumed the form of a cirro-cumulus cloud, and drifted away leeward. The weather was fine when I observed this meteor, but next day it became very unsettled."

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JANUARY 1871.

By W. R. Birt, F.R.A.S.

Day	* Supplement ☾ − ☉ Mid	Objects to be Observed
	° ′	
23	142 7	Mare Humboldtianum, Gauss.
24	130 7	Langrenus, Vandelinus, Petavius, and Furnerius.
25	118 28	Mare Nectaris, Isidorus, and Capella.
26	107 7	Fracastorius objects in the interior. †
27	96 2	Abulfeda, Almanon, and Tacitus.
28	85 7	Ptolemæus, Alphonsus, and Arzachel.
29	74 18	Sun-rise on Tycho, Straight Wall.
30	63 29	Plato, spots and streaks on the floor.
31	52 36	Mare Serenitatis, its dark border on the west.

* Supplement ☾ − ☉ is equal to the angle formed by the incident solar rays on the Moon's surface, and the same rays reflected from the Moon to the earth.

† Fracastorius. Several objects on the floor are connected by lucid streaks, some of which have been found to consist of minute craterlets.

Observations of the above objects may be sent to W. R. Birt, Cynthia Villa, Walthamstow.

SOLAR SPOTS.

Sir,—Many persons observed a spot on the Sun through the fog on the 18th ult., but its telescopic appearance deserves notice. With 2·9-inch refractor, and power 74, at 1¾ h., it was found to consist mainly of two umbræ of unequal size, the larger having an unusually large black nucleus, quite round, surrounded with a narrow grey ring, which was close to the

W. side of the umbra. There was also another black patch, of smaller dimensions, near the opposite side. The diameter of the large nucleus I estimated from subsequent measures of the umbra to be fully 20″. I have not seen any notice of a brighter ring surrounding the *nucleus* having been before observed, but the inference is obvious that its relation to the "cloudy stratum" of Dawes is analogous to that of the brighter inner edge of the penumbra to that part.

On the 20th at 10h., I could find but traces of 3 or 4 darker specks on a very dark umbra of very similar form, while some small spots E. had tiny black points in their umbræ.

I am, Sir, yours truly,

Dec. 14, 1870. T. H. BUFFHAM.

Description of the Cufic-Arabic Celestial Globe in the Borgian Museum Velletri; from the work of S. Asseman. Padua, 1790.

The inscription states that it was made by Caissar (Cæsar), son of Abi Alcasem Alabraki, by order of Mohamed Al Kamel (sixth king of the Jobite dynasty of Egypt, and a great patron of learned men), in the year of the Hegira 622 (corresponding to A.D. 1225: therefore twenty-seven years before the epoch of the Alphonsine Tables, and 212 years before the Tables of Ulugh Beigh); and that 16° 46′ was added to the places of the stars in the Almagest (in order to bring them up to the epoch of the globe: this is allowing 1° in sixty-six years for precession). The polar star on the globe is $5\frac{1}{2}$° from the pole. The globe is made of brass or some yellow metal, and is of fine workmanship. It has rude delineations of the forty-eight ancient constellations, engraved in double lines, between which is red enamel. The figures are represented fronting the spectator. The stars, embossed in silver and laid down to the 5th magnitude, inclusive, are represented by small circles of different sizes, without rays. The names of the principal stars and constellations are also in silver. The diameter of the globe is 8·6in., and with the four legs of its mounting the height is $19\frac{3}{4}$ inches. The Meridian and Horizon circles are divided, according to an ancient mode, into sixty principal parts, each of which is subdivided again into six. Two of the four curved legs (concave externally), one opposite to the other, are also graduated to correspond with quadrants of the Meridian Circle. The Zodiac has, besides the animal figures, the usual symbols for the signs.

The Cufic characters in which the names are engraved are very minute, contracted, and un-pointed; so that in some instances they have baffled the skill of the practical Orientalist Asseman to make out the meaning.

This very curious globe, probably one of the oldest astronomical instruments in existence (another is in the Mathematical Saloon at Dresden), appears to have been brought from Lusitania, and adorns the museum which was formed at Velletri, on the southern slope of the Alban hills, by the wealth and antiquarian zeal of Cardinal Stephen Borgia. The learned work of Asseman devoted to its illustration contains an explanation of the names and figures (the former are also given in the modern Arabic characters), and a commentary, with two planispheres made from the globe, and also a small drawing of the globe itself and its circles. A dissertation is added on the astronomy of the Arabians, with extracts from some of their astronomical writers, and two letters about the globe from the Astronomer Toaldo.

I hope to examine carefully the names on this globe, in order to note variations from those in the catalogue of Ulugh Beigh.

GEORGE J. WALKER.

ASTRONOMICAL OCCURRENCES FOR JAN. 1871.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon —
Sun	1		Sidereal Time at Mean Noon, 18 42 47·0	3rd Oc. D. 1st Oc. D. 3rd Ec. R. 1st Ec. R.	11 13 14 31 15 43 52 17 14 12	8 13·2
Mon	2		Saturn's Ring: Major Axis = 34″·0 Minor Axis = 15″·1	2nd Ec. R. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	7 23 58 11 50 12 21 14 5 14 37	8 56·9
Tues	3		Meridian Passage of the Sun, 4m. 41s. after Mean Noon	1st Oc. D. „ Ec. R.	8 58 11 42 57	9 42·7
Wed	4	11 58 12 38 2 43	Occultation of ζ Tauri (3½) Reappearance of ditto Conjunction of Moon and Jupiter, 1° 32′ N.	1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	6 17 6 50 8 32 9 5	10 30·7
Thur	5	7 49	Occultation of μ Geminorum (3)	3rd Sh. E. 1st Ec. R. 2nd Oc. D.	5 56 6 11 48 16 55	11 20·8
Fri	6	9 24 9 30	○ Full Moon Occultation of δ Geminorum (3½) Eclipse of the Moon: visible at Greenwich			12 12·4
Sat	7	6 17 19 18 1 57	Occultation of μ² Cancri (5½) Occultation of η Cancri (6) Conjunction of Moon and Uranus, 0° 50′ S.	2nd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	11 3 12 18 13 40 14 57	13 4·4
Sun	8			3rd Oc. D. 1st Oc. D. 3rd Oc. R. „ Ec. D.	14 34 16 17 17 7 17 16 17	13 55·9
Mon	9			2nd Oc. D. „ Ec. R. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	6 4 9 59 53 13 36 14 16 15 50 16 31	14 46·4
Tues	10			1st Oc. D. „ Ec. R.	10 43 13 38 12	15 35·6
Wed	11	10 15 11 14	Occultation of ν Virginis (4½) Reappearance of ditto	2nd Sh. E. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	4 17 8 2 8 45 10 17 11 0	16 23·8
Thur	12	7 11	Conjunction of Moon and Mars, 2° 39′ S.	1st Oc. D. 3rd Tr. E. „ Sh. I. 1st Ec. R. 3rd Sh. E.	5 10 6 55 7 16 8 7 6 9 56	17 11·7
Fri	13	18 57 15 23 4 6	☾ Moon's Last Quarter Occultation of 80 Virginis (6) Conjunction of Venus and Mercury, 3° 28′ N.	1st Tr. E. „ Sh. E.	4 44 5 29	18 0·3
Sat	14	15 25	Opposition of Uranus	2nd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	13 23 14 55 16 0 17 35	18 50·7
Sun	15	14 27 15 20	Occultation of o² Libræ (6) Reappearance of ditto Illuminated portion of disk of Venus = 0·989 of Mars = 0·916			Jupiter — 9 26·1

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Jupiter —
Mon	16		Sidereal Time at Mean Noon, 19 41 55·4	2nd Oc. D. „ Ec. R. 1st Tr. I. „ Sh. I.	8 22 12 35 45 15 22 16 11	9 21·9
Tues	17	13 13	Inferior Conjunction of Mercury and the Sun	1st Oc. D. „ Ec. R.	12 30 15 33 34	9 17·6
Wed	18	16 19	Conjunction of Moon and Saturn, 0° 16′ N.	2nd Tr. E. „ Sh. E. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	5 11 6 54 9 48 10 40 12 3 12 55	9 13·3
Thur	19		Meridian passage of the Sun, 10m. 57s. after Mean Noon	1st Oc. D. 3rd Tr. I. 1st Ec. R. 3rd Tr. E. „ Sh. I. „ Sh. E.	6 57 7 47 10 2 30 10 22 11 16 13 57	9 9·1
Fri	20	12 32 0 45	● New Moon Conjunction of Moon and Mercury, 4° 48′ N.	1st Sh. I. „ Tr. I. „ Sh. E.	5 9 6 30 7 24	9 4·9
Sat	21	7 16	Conjunction of Moon and Venus, 1° 25′ N.	1st Ec. R. 2nd Tr. I.	4 31 20 15 45	9 0·7
Sun	22		Saturn's Ring: Major Axis = 34″·4 Minor Axis = 15″·12			8 56·5
Mon	23			2nd Oc. D. „ Ec. R.	10 42 15 11 35	8 52·3
Tues	24			1st Oc. D.	14 18	8 48·1
Wed	25			2nd Sh. I. „ Tr. E. „ Sh. E. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	6 52 7 34 9 32 11 36 12 35 13 51 14 50	8 43·9
Thur	26			1st Oc. D. 3rd Tr. I. 1st Ec. R. 3rd Tr. E. „ Sh. I.	8 45 11 17 11 58 1 13 53 15 16	8 39·8
Fri	27			1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	61 3 7 4 8 18 9 19	Moon — 5 26·3
Sat	28	1 14	☽ Moon's First Quarter	1st Ec. R.	6 26 53	6 8·4
Sun	29					6 51·6
Mon	30	9 44	Occultation of δ^3 Tauri (5)	3rd Ec. D. „ Ec. R. 2nd Oc. D.	5 18 17 7 50 46 13 5	7 36·4
Tues	31	6 27	Conjunction of Moon and Jupiter, 1° 44′ N.	1st Oc. D.	16 7	8 23·4

THE PLANETS FOR JANUARY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	20 10 15	−21 15	6″·8	1 27·2
	15th	20 9 13	17 25½	9″·8	0 1·2
Venus	1st	19 12 8	−23 20½	9″·8	0 29·3
	15th	20 27 6	20 29	9″·8	0 49·0
Mars	1st	12 7 22	+2 2	9″·4	17 21·7
	15th	12 23 1	0 39	10″·6	16 42·3
Jupiter	1st	5 11 46	+22 3	44″·4	10 27·3
	15th	5 5 41	22 28	43″·0	9 26·1
Uranus	1st	7 48 54	+21 38½	4″·2	13 4·0
	17th	7 45 59	21 46	4″·2	11 58·2
Neptune	1st	1 12 47	+5 5	—	6 28·9
	17th	1 13 6	5 56½	—	5 26·4

Mercury passes the meridian an hour and a half after noon on the 1st, the interval decreasing till the 17th, when the planet is in inferior conjunction with the Sun, up to which time it is an evening star and will be fairly visible.

Venus will be just visible in the evening, but so close to the Sun as to be scarcely worth observing.

Mars may be seen after midnight, but its diameter is too small to repay observation.

Jupiter is still as splendid an object as ever, rising at dusk.

Uranus is visible during the whole night.

ASTRONOMY IN THE TIME OF KING JAMES I.—In a household account-book of the revenue of England about 1610, among the officers about the King's person are: six surgeons at from 60*l.* to 30*l.* per ann.; three "phisitions," two at 100*l.*, one at 60*l.*; two "apothecaryes," at 26*l.* 13*s.* 4*d.* and 11*l.* 2*s.* 6*d.*—these to attend to the proper admixture of drugs, &c.; and an *Astronomer* at 20*l.* per ann., doubtless to prescribe the times at which the doses should best produce the desired effect, and how the baneful effects of malignant planets might be avoided. Our readers will probably agree that the salary was equal to the value of the services received.

NEW EQUATORIAL MOUNTING.—We have had the pleasure of inspecting a very neat portable equatorial mounting by Messrs. Solomons, adapted to moderate-sized telescope, say from three to five feet in length. This stand is universal, and can be readily adapted to the latitude of any place of observation; it can also, by means of an efficient clamping screw, be rapidly adjusted in azimuth, and—a great desideratum—can be levelled by means of screws in the head of the stand; in fact, all necessary alterations can be accomplished without altering the position of the tripod.

BOOKS RECEIVED.—We have to acknowledge, from Messrs. Sampson Low & Co., the Christmas number of the *Monthly Bulletin*, most admirably got up, and containing notices of recent foreign, colonial, and American publications; also of the *Publishers' Circular* of Dec. 17, which is a periodical most inexpensive, and yet most useful to all who wish to be well posted up in recent publications.

We owe our thanks to Mr. G. J. Walker for a work of great interest and research, entitled *Arabic Names of the Stars and Constellations*, which he kindly presents to our subscribers this month.

THE TABLE OF CONTENTS.—"The old plan of having the Table of Contents for each month's number of the *Register* was far more convenient than that lately adopted of putting it on the first page, for it was far easier to find any article wanted while the numbers were *unbound*; and the Index of each volume renders the present Tables of Contents of no value. When it was outside on the cover, it was seen at once; now it has to be looked for inside, and each number opened."—J. JOYNSON.

[The Table of Contents was transferred from the wrapper to the body of the *Register* for the convenience of publication: a better plan is under consideration.—ED.]

WE will think over Mr. A. Woolsey Blacklock's suggestion with respect to printing Colonel Strange's figures for engraving on the scales of astronomical instruments.

STAR MAPS.—Mr. H. Cox will probably find what he wants in the *British Association Catalogue*, edited by Baily. The *Handbook of the Stars*, by Mr. Proctor, 1866, contains a complete list of stars up to the 5th magnitude.

NEW BOOKS.—*A Monograph on the Total Eclipse of the Sun, as visible in Sicily*, by Signor Angelo Agnello. A new edition of Beer and Mädler's *Mappa Selenographica*, four sheets folio: Asher & Co., 13 Bedford Street, Covent Garden; price 1*l*. Guillemin's *The Sun*, translated by Phipson; 8vo. 6*s*. cl.

SUN SPOT.—We are indebted to Mr. A. P. Holden for a beautiful photograph of some careful drawings made by him of a great sun spot observed at 8.0 A.M. on September 23, 24, 28, and 29, with a three-inch refractor, powers 60 and 130.

Will some reader of the *Astronomical Register* favour me with a few hints on protecting silver circle scales from tarnish? The circles of my equatorial got tarnished soon after I had it, and at the maker's suggestion, I covered the silver, after cleaning it, with some transparent varnish which he gave me. I found it impossible to apply this so that it should dry free from streakiness; but it answered my purpose till a few months ago, when, actuated by a desire to have a general clean up, I dissolved off the film of varnish, and now my silver circles are again black. This is annoying in more ways than one, and any regular polishing would soon impair the condition of the graduations. G. F. CHAMBERS.

THE NOVEMBER METEORS.—The November meteors were watched for on the morning of the 14th at Yale College, Connecticut, by six observers, who counted 153 in four hours and forty minutes. In 1869 the number was much larger, and in 1868 there were about 7,000 seen on one morning by a party of observers. From these observations, the inference is drawn that the great meteor stream had this year passed by the orbit of the earth at the time of observation in November. This belt of meteoric matter, it has been calculated, is about 1,000 millions of miles long and 50,000 miles thick, spreads over about one-fourth of its orbit, and has a velocity of 100,000 miles an hour. The November meteors, it is believed, will still be visible for several years, but in smaller numbers each year, until they disappear entirely, to return again in great splendour in the year 1900.

ECLIPSE OF THE MOON.—A partial eclipse of the moon, visible at Greenwich, will take place on the evening of the 6th of January, at about half-past six o'clock.

GREENWICH MEAN TIME.		h.	m.
First contact with the Penumbra . .	Jan. 6,	6	27·3
" " Shadow	"	7	46·2
Middle of the Eclipse	"	9	16·4
Last contact with the Shadow . . .	"	10	46·6
" " Penumbra . . .	"	12	5·5

Magnitude of the Eclipse (Moon's diameter = 1) 0·688.

The first contact with the Shadow occurs at 130° from the north point of the Moon's limb towards the east; the last contact at 127° towards the west; for *direct* image.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.
Anthony, Dr.
Dawson, A.
De la Rue, W.
Erck, W.
Lean, W. S.
Little, W.
Ormester, H.
Ryley, F. B.

To March 1871.
Buffham, T. H.
Cook, James
Elger, T. G.

To April 1871.
Blacklock, A. W.

To June 1871.
Glover, E.
Guyon, G.
Jefferies, J.
Morton, Rev. J.
Squire, H.

To December 1871.
Andrews, W.
Bazley, T. S.
Clermont, Lord
Ellis, W. M.
Freeman, G. T.
Garnett, W.
Gilby, J.
Hall, Rev. R.
Joynson, J.
Longmaid, W. H.
Perrins, J. D.
Roberson, O.
Stanistreet, J. F.
Vallack, Rev. B.
Williams, G. (Liv.)

To June 1872.
Compton, A. S.

December 26, 1870. Subscriptions after this date in our next.

NOTICES TO CORRESPONDENTS.

We are again obliged to postpone several interesting communications.

We have again to request our correspondents to send their papers to us early in the month. They can scarcely realise the inconvenience caused to us by our endeavouring to give insertion to important papers arriving a day or two only before our going to press. Usually communications should be sent not later than the 15th, but we keep space up to the 20th for important letters, notices of recent phenomena, discoveries, &c.

ERRATUM.—In Walker's *Arabic Names of the Stars and Constellations*, p. 13, line 8, *for* Sa'd-al-Aula' *read* Sa'd-al-Bula'.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 98. FEBRUARY. 1871.

CONTENTS.

THE ECLIPSE EXPEDITION.

Owing to badness of weather and other causes there was much disappointment to almost all the observers. The most successful appear to have been Lord Lindsay (who really, as far as the chief object of his journey is concerned, viz., the obtaining of photographic pictures and drawings by eye-witnesses, had good success, as will be seen from our report of the meeting of the Royal Astronomical Society) and the Sicilian party. The distinguished observers who went to Oran, in Algeria, saw absolutely nothing. We fear that the observations made with the polariscope have proved failures. This is most disappointing, as it was of the utmost importance that they should be carefully and satisfactorily made The *Saturday Review* gives the following account of the results, as far as they are at present known, of the Sicilian expedition:—

But it is time to describe what was actually seen by those of the expedition who were successful; and it is with great regret that we notice that among their number was not included Mr. Lockyer himself, to whose energy it was chiefly owing that success was achieved at all, and whose own observations would have been the most valuable, from his complete mastery of the science of spectroscopy, and the light which, by means of it especially, he has been able to throw upon the physical side of astronomy. We shall not attempt to enter into a minute discussion of the results gained, but will rather point out their general bearing; and this will be perhaps assisted by a few words of explanation. In total eclipses the sun is seen to be surrounded, first by the "chromosphere," a bright rim of reddish light, with an outline moderately well defined, presenting generally the same phenomena, though sometimes hidden when the moon happens to be particularly near the earth; and there is no reason to doubt that this consists of a layer or layers of incandescent gas, chiefly hydrogen, arranged in order of density. Secondly, the coloured prominences projecting here and there from the edge of the chromosphere. These now present no difficulty whatever. They are discernible at all times by the Janssen-Lockyer method, and are known to be outbursts of heated hydrogen, many of them thousands of miles high, and constantly varying in position and magnitude. Thirdly, the corona. Of this sphinx of a phenomenon it is not only hard to say what it is, but even to say what it looks like; for while some observers on previous occasions have noticed only a finer halo surrounding the chromosphere, others have extended this into well-defined and gorgeous shapes, have given it brilliant streamers extending heaven knows how many diameters of the sun in length, and even an elaborate organism with bundles of parabolic rays. The American astronomers at the last eclipse declared that they found iron in its composition, even in that of these mysterious rays or streamers. What then does this eclipse reveal, as far as the accounts have come to hand? In the first place, there is a corona—which it is some relief to hear—and this corona is solar. The halo of which we spoke as surrounding the atmosphere is in fact an apparently achromic continuation of it; and it was observed by Professor Watson, well known in the United States as a patient and successful observer, to extend to about five minutes in height beyond the solar disc. He describes it as having the appearance of a shell, that well-known phenomenon of concentric layers which is presented by the nuclei of most comets which are near enough to be examined. Professor Watson also saw one of the "streamers" so often spoken of—and saw it disappear! It seemed to float away, he says, "like a veil." If, then, this observer is to be trusted—and there is no observer living who is more worthy of trust as regards a thing actually seen—the streamers are an atmospheric effect, and the corona, if we may continue to use the name, appears to be a solar envelope of gas surrounding the coloured gas of the chromosphere. Next comes the observations of the polariscope, some of which have not yet reached us, but those which have at present come to hand are distinct enough. Briefly stated, they are these:—The corona (or outer chromosphere) is strongly polarised; therefore it shines with reflected light. It is polarised in a plane different from that reflected from the moon's surface at the moment of totality; therefore it is not atmospheric. It may hence be fairly considered to be a solar appendage, reflecting in an eclipse the light of the obscured sun. Leaving further details, we turn lastly to the spectroscope; for, as no photographs have as yet reached England, it is too soon to pronounce on the value of those which have been made. The most important spectroscopic observation was made by Mr. Burton, an observer fully to be trusted, at Agosta. He saw in the first place the ordinary spectrum of the chromosphere, including a certain line in the yellow part never before noticed; then the hydrogen lines, which were to be expected especially at the edge of these, and which simply show the comparative lightness of the substance which produces them; and lastly—a most important discovery—a clear green line by itself outside the part of the spectrum due to the chromosphere, and at about the same position as that noticed by the American astronomers last year. What is this green line? It cannot well be a hydrogen line, for, if it were, why were not the other well-known lines of hydrogen present? It cannot be iron, for the same reason. It is like no substance in heaven or earth which is dreamt of in our philosophy. It is a gas—or shall we call it a metal?—which is so extremely light that it floats above the hydrogen, which is in the region of so low a temperature that it alone of the materials in its neighbourhood can yield any spectroscopic results, and which is green in colour. But for the fact that, as the polariscope shows, it shines chiefly by reflected light, this corona would, at all events as far as this particular gas is concerned, be green; and as this is the very outside shell of all the shells of the sun hitherto discovered, we may even lay it down as an interesting fact in natural science that, as far as we know it, the sun is green on the outside. The only thing now left is that our chemists should produce this hitherto unknown substance in their laboratories, as they have already produced the similar thallium; or even, perhaps, the Janssen process may be repeated over again, and the workers with the spectroscope may not rest satisfied till they have traced this mysterious line in open day, and without the aid of an eclipse. Nay, what if it has been traced already? If this remote green line is the same which has been found in the aurora, and which is believed to have been found in the zodiacal light, what are we to say of such a discovery? Have we in any sense, with any limitations, touched the edge of that cosmical ether, that unknown substance, which everything points to and nothing shows, which is yet perhaps revealed under certain magnetic conditions in the higher regions of our atmosphere; and can this mysterious gas be nothing but a zone of the pervading ether itself rendered luminous by the intense heat of the sun? Perhaps this may be a conjecture to which sober science has no right as yet to proceed; but whatever the case may be, this green line in the spectrum of the outer chromosphere of the sun is the door by which those will for a long time enter in who wish to search with success the regions of cosmical science as yet unexplored.

It is very desirable that the Astronomical Society should, according to the suggestion of the Astronomer-Royal, appoint a committee to receive and digest all the reports which may be formally or otherwise brought before them, as it is only by such means that the real value of the various observations made can be ascertained.

We have received an interesting paper from the Rev. H. Ingram, on the eclipse of the sun, which we are obliged to postpone till our next number.

Mr. Buckingham writes—

The late eclipse of the sun was well seen here, and the principal phenomena that I observed were the following:—

1. A cord of extraordinarily brilliant light binding the edge of the moon; the effect, I suppose, of diffraction.

2. The perfect definition of the solar spots up to their disappearance behind the moon.

3. The perfect sharpness of the cusps.

4. The visibility of the moon's limb for a short way outside the cusps.

The diminution of light and the effects on the landscape at the time of greatest phase were very remarkable.

THE ECLIPSE OF THE MOON.

The weather was so unfavourable on the 6th that the eclipse of the Moon could not be observed at all in the East of London. We have received the following from Mr. Birmingham:—

Besides the scenic effects, which were very interesting, there was little to be noted.

A small red star was occulted at 8h. 21m. Dublin Mean Time, and the limb at the Leibnitz Mountains passed within 84″ of δ Geminorum, the small comes of which was easily seen. The outline of the shadow appeared to correspond very exactly with the field of an eye-piece that includes about 1° of space, which is much less than the diameter of the calculated shadow.

M. H. Cox, of Weston-super-Mare, writes :—"The eclipse of the Moon, on the 6th, was seen here at times very favourably, particularly between the hours of eight and nine, but from that hour it became very cloudy, and we only managed now and then to catch a quick glimpse of it."

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Third Meeting, January 13, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-four presents were announced, and, in addition, a coloured sketch of the landscape effects during the Total Solar Eclipse, presented by Mr. Penrose. The thanks of the meeting were given to the respective donors.

Lord Lindsay,	Rev. J. C. Jackson,
T. Ribton, Esq.,	W. H. Mahony Christie, Esq.,
S. Cottam, Esq.,	and
J. Drew, Esq.,	Ankietani F. Nursing Row,

were balloted for, and duly elected Fellows of the Society.

Mr. Perigal, Mr. Penrose, and Mr. Gibbs, were duly appointed auditors of the Treasurer's accounts.

The following papers were announced and partly read; those on the Total Solar Eclipse, from members of the expeditions to Sicily, Cadiz, and Gibraltar, taking precedence :—

On the Solar Eclipse of December 22, 1870: by Mr. Ranyard.

The writer was happily favoured with fair weather, and by going up a hill with his instruments at Augusta, near Catania in Sicily, was able to report that there was strong radial polarisation from the corona and perpendicular polarisation from the atmosphere. His observations were corroborated by his companions, Mr. H. B. Samuelson, M.P., and Mr. Clifford, and they were all astonished at the strength of the polarisation.

Observations of the Total Solar Eclipse, by the Rev. J. Perry.

The author, being prevented by his lectures and observatory work from attending the meeting, sent the following short notes of the results obtained by the party under his charge. The salient points were :—

1. Form of Corona.—This was approximately quadrilateral, but not very well defined. Most extensive over the prominences. No radial streamers, but some gaps in the outline.

2. Within the corona was a narrow band of silvery light surrounding the moon's disc, and not exceeding one-tenth of its diameter. This band was uniform in colour and intensity and did not fade gradually into the light of the corona, but preserved a definite form.

3. The corona was hardly visible till totality was complete, but it continued to be seen some time after that phase was over.

4. As to the nature of the corona the results are negative only. The sky was never quite free from clouds, and the author could not get sufficient light through his powerful spectroscope; but Capt. Maclear, observing with a smaller instrument, saw some bright lines in the corona, which were also visible, but fainter, on the disc of the moon. This shows that the observations should be received with great caution.

Capt. Noble wished to make one remark, viz., that his friend, Mr. Watkins, of the R.A., who observed at Gibraltar, and had no preconceived theory to support, told him that the corona most undoubtedly followed the prominences, extending further whereever these occurred. This indicated beyond question that the corona was solar in its origin.

Mr. Hudson, as one of the Cadiz party, said that in one or two points he differed slightly from Mr. Perry's notes. The quadrilateral form was seen by all the party, but there were some interruptions in it. One gap was much larger than others. It is visible in the American photographs, and must have been a real vacancy, and not caused by clouds. The corona was seen before the totality and afterwards too. It was visible for 2m. 50s., the totality lasting only about 2m. 10s., so that 40s. or 42s. were in excess. It was difficult to distribute this period between the beginning and the end. Mr. Perry thought it lasted 35s. after the totality, which left only 5s. or 7s. for the beginning, but probably the clouds concealed it then, producing the apparent inequality. Mr. Perry says this was an unexpected effect, but he must mean only as to the eye observations, the speaker having been expressly asked to watch for such an event.

Capt. Maclear: I looked carefully with my spectroscope at a point in the corona, about 8′ from the moon's edge, at the commencement of the totality and saw several bright lines. I then moved to the centre of the moon's disc and saw the same bright lines, but fainter. I passed on to about 8′ from the limb on the other side and found the lines stronger again, and I think one more bright line made its appearance. I then went close to the limb and saw three more bright lines, two green and one blue, between D and F. The light of the sun broke in and all disappeared, being replaced by the ordinary solar spectrum The corona gave no continuous spectrum, but only a faint and diffused light and bright lines. I recorded four such lines on one side of the moon and on its disc, and five on the other side. There were C, D or very near it, E, *b*, and F. I feel pretty sure of the identity of D and F, but the others were more uncertain. My only means of knowing them were the colours and my knowledge of their position in the spectroscope. The limit of 8′ from the moon's disc was used as part of my programme. The corona extended much further, and was of a silvery colour.

Dr. Huggins said that, with the view of saving trouble in making explanations during the discussion, it would be well to draw a distinction between the inner well-defined ring of white light, shown in a drawing by Lieutenant Brown and described by Father Perry, and the surrounding quantity of fainter and fading light. The term *lucosphere* had been suggested to distinguish the former from the chromosphere and corona.

Mr. Proctor suggested the terms *aureole* and *corona*, but

Dr. Huggins thought that as aureole had sometimes been applied to the whole corona, the word lucosphere would be better.

The Rev. F. Howlett said that Mr. Watkins showed his sketch to the speaker, and this distinctly proved the correspondence of the ring of silvery light, and not the corona generally, with the prominences which it followed round.

Capt. Noble: Mr. Watkins told me the *corona* followed the prominences, whatever he meant by the word corona.

Capt. Maclear, in answer to questions, said his instrument was a 4-inch refractor, equatorially mounted, with a Browning's pocket spectroscope adapted to it. He had no means of comparing the lines seen with those of gases or vapours. When observing the bright lines on the Moon's disc he did not rotate the eye-piece.

Mr. Hudson wished to remark that in Mr. Perry's report he had made no allusion to the polarisation observations, as he believed that the effects observed were all due to the surrounding light from clouds and the atmosphere. The plane of polarisation as noted by himself (Mr. Hudson), Mr. Ladd, and Mr. Baines, was the same whatever they looked at. He might also mention that the light on the moon's disc was greater than he should have supposed. It was nothing like so dark as he expected. The colour was green, and looked like green velvet, of the tint of the olives they had every day at dinner. When looked at with the double-image prism he got a sufficient amount of light to detect the change from light to darkness as the prism was rotated. The light of the clouds was more visible on the corona than on the Moon.

Mr. Ladd: I was using a plate of arragonite and a double-image prism, and saw the coloured rings of the crystal on the moon's disc, but not before the totality. The intensity increased during the totality. The same effect was produced beyond the corona, and was brightest over the corona itself, fading away outside. We set this down as due to the clouds and atmosphere. The plane of polarisation was, I believe, radial from the moon's disc. I tried both sides. My whole impression is, however, one of doubt.

Mr. Hudson: This direction of the plane does not agree with my impression nor that of Mr. Baines. We found it neither radial nor horizontal at the top and bottom of the moon's disc, but with an angle of 45° to the radius on the moon, on the corona, and on the moon's disc during the partial eclipse. These observations were not made all over the limb, but at three points at least. Clouds prevailed nearly up to the totality, but during this phase the effect was the same on the disc and on the corona. I attributed the whole to the clouds.

The Astronomer-Royal: It is clear that the question of polarisation is left just where it was. With regard to the different parts of the corona, I cannot do better than place before the meeting the representations made by Mr. F. Baily and myself in 1842. Mr. Baily observed at Pavia, where it was fine weather. I was at the Superga, near Turin, where it was cloudy. I saw a ring of light one-sixteenth of the breadth of the Moon, while Mr. Baily saw a quantity of light which surprised him, extending to the width of the moon's whole diameter. A comparison of the sketches shows that there is a narrow border of light, ring-formed, and also a quantity of light, radial and very extensive, which may have a very different origin, and be of great importance.

On the Total Solar Eclipse: by Lord Lindsay.

The author went out to Spain independently of the Government expedition, and arrived at Cadiz on December 4. There was some difficulty at the Custom-house, 800*l*. being demanded for duty; but after telegraphing to Madrid, and ventilation of the subject in the papers, the instruments were passed. A position about 14 miles from Cadiz, and not far from Xeres, was chosen, being a vineyard belonging to Mr. Campbell, who assisted the party in every possible way. The instruments comprised a 12½-inch silvered glass reflector for photography. This was mounted equatorially for the author's observatory in Scotland, but being fixed on a strong wooden platform, was tilted so as to suit the latitude of the station. The weather was so bad that seven days elapsed before the proper adjustments could be made. The telescope was protected by a house, which was taken out with it, measuring 20 feet by 11 feet—part being used as a dark room. The whole front could be opened when the pictures were to be taken. Other instruments were: a 6-inch equatorial, by Troughton and Simms, fitted with a Browning's star spectroscope, lent by Mr. Gill, of Aberdeen—this had one prism of 60°, and was used by Lieut. Brown, R.A.; an altazimuth, by Troughton and Simms, which was employed as a transit circle; and a $3\frac{1}{4}$-inch telescope, by Cooke. The weather continued most unfavourable, the 21st being the only really fine day. The 22nd was cloudy till eight o'clock; it then rained for half-an-hour, after which the sun became visible through thin clouds and the breaks in it. The party was at this time augmented by the arrival of Messrs. Reed, Pitman, and Greaves. The latter took charge of the telescope fitted for recording the position of the prominences. The others were to make eye-sketches of the corona. The first contact could not be observed, but several negatives were taken during the partial eclipse, until a small derangement of the slide happened. The totality then commenced, and the sky cleared for about a space equal to five diameters of the sun. The assistants were all at their posts. Mr. Rogers received the plates from the dark room, handed them to Lord Lindsay, and received them back from him after exposure. Messrs. Davies and Winslow were in the dark room, where they prepared and developed the plates, and Mr. Scott watched the finder. The party were all well drilled, and it was found possible to take twelve or fourteen pictures during the time of totality, but nine only were actually secured on the day of the eclipse, as the exposure of some was purposely lengthened. The totality lasted 2m. 8s., and one minute after clouds put an end to all further work. One positive has only yet been procured from the negatives, which was shown, and also a number of photographs of the observatory, instruments, and parties engaged. [The picture showed a number of prominences and the corona, much more extensive on one side than the other, being evidently one of the earliest taken.] Lord Lindsay then exhibited and explained the camera and dark slide. He tried to revert to the instantaneous apparatus after the totality, but the clouds stopped him. Six slides and six baths were in use during the operations. He received various reports from the other members of the observing party. The four sketchers were very successful. Mr. Becker and another observer worked with Nicol's prism, and Savart's band prism for polarisation, but could make no observations before totality, on account of the clouds. As totality approached the sky brightened. During totality polarisation was distinctly evident, but there was no difference between the moon's disc and the corona. The general effects were very grand; the sky became of a deep purple, and just before totality some red and yellow tints came on, making the beholders livid and ghastly. The northern cusp of the sun broke up into a string of pearls at the last moment. A flock of geese came towards one of the party as if for protection, and the fowls huddled together as if going to roost. Lord Lindsay saw Venus and, he thought, one other star. The shadow advancing through the air was looked for, but not seen by any one.

The Astronomer-Royal handed in two short papers written by officers at Gibraltar, and sent to him by the Admiralty. They showed very different appearances of the corona. He suggested that as he was likely to receive more such communications, it would be desirable to appoint a committee of the President and a few others, to whom he would hand such papers, and they might then be compared with those sent to the Society, and the results given in a digested form, instead of letting each stand alone. He could also supply them with the records of the eclipse of 1860, which would be useful for comparison, although there were then only one set of observations with the polariscope, and none with the spectroscope.

Observations of the Solar Eclipse: by Lieut. Brown, R.A.

The author was attached to Lord Lindsay's party, and was stationed at his observatory erected in Mr. Campbell's grounds, about five miles from Xeres. His instrument was a 6-inch refractor of 7 feet focus, with a single prism spectroscope, by Browning. The telescope was equatorially mounted. The spectroscope had no automatic arrangement for recording the lines seen, but Lieut. Brown made a contrivance himself for this purpose, without which he could not have measured the lines. On the 18th December he measured and mapped the sun spots, several of which it was calculated would be on the disc at the time of the eclipse. One large spot had much changed its appearance by that time, while two others of a spiral form continued much the same. Lieut. Brown exhibited a large oil painting of the total eclipse, showing the prominences, the lucosphere, and an extensive corona. He also gave the times of contact with the spots, and noted that the moon's disc was darker than the umbra of the spots. He observed the bright lines of the prominences before and after the day of the eclipse: one of the protuberances thus seen was 30,000 miles high. He saw C, a line near D, E, and F. On the day of the eclipse the sky was very broken, and the first contact was lost. The large spot was near the edge of the disc, and was accurately delineated. No spots could be seen on the moon, neither could its disc be seen, except where it crossed the sun. No serrations were generally visible on the moon's limb, but on crossing the sun spots some jaggedness was seen. He then went to the spectroscope and recorded the principal solar lines for comparison. The totality then commenced, and he adjusted the wires of the finder about 8′ from the moon's disc, where he got a continuous spectrum, with no lines either bright or dark; he closed the slit gradually, but no lines appeared; he examined the corona at various heights, but everywhere with the same result. He searched especially for Professor Young's line, but could find nothing. What the author calls the true corona is far higher and more diffused than the irregular pearly band close to the moon's disc. There were no lines in this latter portion; either none existed, or the haze obscured them. He looked in the finder and found the wires in good adjustment, and in the places he wished. Three prominences were examined: one marked B was tongue-shaped, and had been seen the day before, from which its position and form had been predicted. The corona had several gaps or bendings in. The achromatic chromosphere, or inner white ring, was free from rays. The rest of the corona was of a faint violet colour, very jagged at the borders and with great gaps, as shown in the drawing. For the inner portion, outside the chromosphere, he suggests the name of lucosphere. This ring surrounded some of the prominences but not others, and was pressed inwards at the gap in the corona. He believed the corona was entirely a solar appendage. The prominences were bright red, with a violet tinge at the upper edges. The tongue-shaped one seemed flattened at the top as if by blowing—perhaps the sun's rotation might have something to do with this. The drawing was made just after the totality, before he had seen the sketches of the other observers. The prominence B, examined by the spectroscope, gave the lines C, C^1 (near C), D, E, *b*, and *h*, their angular values being reduced to Kirchhoff's measures. It was about 2½ minutes or 55,000 miles in height. Prominence A had six lines, which were not exactly measured. They were probably C, C^1, one near D, E, F, and G, and a short broken one near F. These lines were all shorter than those in B, and showed less change. The corona was again examined, with the same result as before. The wires were then placed on the gap, when the spectrum almost faded away, although the slit was widened and no lines were seen. The totality, which commenced at 14m. 52·5s., was over at 17m. 0·5s., giving 2m. 8s. for its duration. The ordinary spectrum and dark lines came into view, and clouds shut up the observations.

Dr. De La Rue wished to call attention to the results obtained by Lord Lindsay, and first to notice the enterprise and public spirit with which he had carried on his operations regardless of the refusal of Government aid, and independently of it. Having originally offered to join any such expedition, when the anticipated assistance was refused he still determined to go, and carried on his preparations as before. Referring to the single photograph shown, in which the top was nearly the north point, it would be seen that on the side covered by the advancing moon there was little of the corona visible, while on the other side it was broad and extensive. Probably other photographs would show the reverse of this, as the eclipse progressed. This indicated that beyond the lucosphere there was something illuminated by the sun. This might be something near the moon, but beyond our atmosphere. He also noticed that there was no special bulging out of the corona over the prominences.

Mr. Proctor wished to be shown how anything near the moon could produce the corona, upon which a short discussion took place between him and Dr. De La Rue, each drawing diagrams to illustrate his views.

Mr. Proctor also drew attention to the likeness between Lieut. Brown's drawing and description, and those referred to by the Astronomer-Royal.

Mr. Hudson, in watching for the formation of the corona, became conscious of the presence of the moon's disc against the corona, which suggested that the light undoubtedly came from behind it.

Lieut. Brown: The moon was much darker than the surrounding sky.

The President: The moon during a solar eclipse is the blackest thing I know.

Capt. Noble: I have seen the moon's disc outside the sun at a partial eclipse in England. I should like to know whether, when the sketch was made, the sky was quite clear.

Lieut. Brown: Quite clear, but perhaps clouds formed a limit to the corona.

Capt. Noble: At Oran the weather was like a wet and windy day in October. On the day after we saw a halo round the sun through cirro-stratus clouds, and some here will recollect I said "I wish we could have seen the corona like this yesterday." It looked like a corona without an eclipse.

Lord Lindsay: There was the faintest trace of haze, but otherwise it was particularly clear during the totality.

Observations of the Total Solar Eclipse: by Mr. Abbay.

These were principally spectroscopic, and were made with an ordinary chemical spectroscope of two prisms, belonging to Professor Young. It was not adapted to any telescope. The slit was partly covered by a small prism for introducing spectra of comparison. The field included about 4°, and therefore took in a space equal to several diameters of the sun or moon. The spectroscope was carefully adjusted before totality, and showed the Fraunhofer line D single and B very black. These dark lines faded out and were replaced by three bright lines, in the positions of C, D, and F, and two others—one near *b* and another near F. There was no continuous spectrum, but the lines were bright, on a dark ground, extending right across the field, and therefore not due to the prominences alone. Some of the lines were compared directly with the chemical elements, by means of an induction coil and vacuum tubes. After totality D was again seen as a single line, and four thick lines were noticed between E and *b*. The slit was about the 200th or 250th of an inch wide. The middle of the corona appeared to have a very distinctly marked radiate character. For half or two-thirds of its diameter it was of a pearly tint, and threw strong shadows, like moonlight does. Professor Winlock found Kirchhoff's line 1474 at the distance of three radii from the sun's limb, and considers it would have been found much further off on a finer day. From having no telescope attached to the spectroscope, Mr. Abbay could not specify the exact point he was observing; but as the whole field was full of the lines, he thinks the corona must be extensive. The hydrogen and iron lines were well identified by his comparisons.

Mr. Buckingham communicated some observations by an officer of a gunboat at Estipona, who saw three shoots of light, about the sun's diameter from its edge. He also observed Saturn about two diameters below the sun in the finder of Mr. Buckingham's large telescope. Mr. Buckingham lost the totality entirely through the clouds, but exhibited a number of photographs of his telescope, the scenery of Spain, and the members of the various parties, taken on board the *Urgent*.

The remaining papers were taken as read, including:—

Observations of the Solar Eclipse of December 22nd: by Baron de Rottenburgh.

Ditto, by Mr. Joynson.

Ditto, by Mr. Dancer.

Ditto, by Dr. Robinson.

Ditto, by Mr. Prince.

Ditto, by Mr. Talmage.

Ditto, by Professor P. Smyth.

Ditto, by Mr. Plummer.

Summary of Sun-spot Observations made at Kew during 1870: by Messrs. De La Rue, Stewart, and Loëwy.

On a presumed new Variable Star in Orion: by Rev. T. W. Webb.

Spots on Plato: by Mr. Birt.

On the Solar Eclipse of December 11, 1870: by Ragonotha Chary, Assistant, Madras Observatory.

On the change of Colour in the Equatorial Belt of Jupiter: by Mr. Browning.

Work done at the Kew Observatory: by Dr. De La Rue.

The meeting, which was a very crowded one, then adjourned.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE LATE SOLAR ECLIPSE.

Sir,—Being prevented at the last moment from proceeding to Gibraltar, to view the eclipse in its totality, I observed it here. First I noticed a notch in the sun's limb at 11.3, when it came out in a break between some clouds. I must have seen it to within half-a-minute of first contact. Directly afterwards the clouds thickened over the sun, and nothing more was visible till 11.31, when they commenced separating, and soon there was a large expanse of blue sky. Snow flakes kept falling during the first half of the eclipse. So far as I could judge with a telescope of 2¼-inch aperture, powers 70 and 150, the limb of the moon was pretty smooth. I wanted particularly to see whether the light of the sun would be dimmed at the time of the middle. From accounts of former eclipses, I was led to suppose there would be a little gloom when ten digits were covered. Nor was I disappointed. At the time of the greatest obscuration, and for about five minutes before, the light of the sun was most sensibly affected; the blue of the sky was beginning to assume a dark hue, and, as seen through trees, the impression was that of an approaching storm. I endeavoured to catch Venus with the small telescope, but failed. The sky was very favourable for observing the latter half of the eclipse. It was interesting to watch the moon's limb recede over two large groups of spots. The last contact, at 1.38 (railway time), I observed very distinctly. The minimum thermometer stood at 25° during the eclipse, and there was no perceptible fall in thermometer or barometer.

Yours faithfully,
S. J. JOHNSON.

Upton Helions Rectory,
Devon.

THE TRAPEZIUM IN THE NEBULA OF ORION.

Sir,—I was glad to see the letter of Mr. S. S. Broughton, in the last number of the *Astronomical Register*. The Trapezium in Orion is an exquisite object, and the question whether or not the component stars are variable has never received sufficient attention. But this is not surprising when we consider that there are but few observers who have appliances sufficiently powerful, and the time to successfully examine it. Mr. Broughton remarks that he cannot find any recorded observations since 1866–7, and also speaks of the desirability of astronomers obtaining numerous observations of the object during the winter evenings. Your correspondent may be interested in learning that the late Mr. Edmund Salter, of Manchester (whose untimely death you referred to in your November number), observed on several occasions 9 stars in the Trapezium, and has more than once suspected the existence of a 10th. On December 3, 1869, and on January 25 and 29, 1870, he saw 9 "certainly," and 10 "probably." Mr. Salter seems to have noticed no variation in the brilliancy of any of the small stars, although he made sketches of their positions, and numbered them in the order of their brilliancy. His drawings almost perfectly coincide with Mr. Huggins' sketch of the Trapezium, which appears on page 55 of the *Register* for 1867.

The 10th star, which Mr. Salter thought could be seen by "glimpses," was situated a little to the east of δ in the sketch made by Mr. Huggins.

There can be no doubt that Mr. Salter possessed very excellent vision, and that his telescope (a 12-in. reflector, mirror made by Mr. F. Bird, power generally used 320) was one of very good definition and great space-penetrating power.

Owing to the want of sufficient evidence, it is impossible to decide whether the small stars in the Trapezium are variable or not. It would certainly appear that they are, if we are to judge from the observations made by Mr. John Browning on January 25 and 26, 1867. In a letter to the *Register* of March 1867, he says that on the former date he "saw 6 stars in the Trapezium, the star marked 6 in the diagram I enclose being easily visible, while the star marked 5 could only be glimpsed at intervals." On January he again observed it, and to his surprise "the star marked 6 was barely perceptible, while the star marked 5 was very plainly seen." Practised observers verified these observations, and Mr. Browning asks, "Can the stars I have alluded to be rapidly variable?" This question has never been answered, and it really appears that Mr. Salter is the only one who has recorded his observations of this object since 1867. Under these circumstances it is advisable that observers working with large apertures should, on all favourable occasions, critically examine the object, and note the relative brilliancy of the component stars. I contemplate making numerous observations of it during the ensuing winter with my 10½-inch Browning reflector, and shall be glad to receive the results of other observers for comparison. If this plan is carried out, it will be easy to determine the various periods of the stars, should they be found to be variable.

As I have before referred to the late Mr. Salter, it may be appropriate to mention here that on January 15, 1870, he observed "19 spots or craterlets on the floor of the lunar crater Plato." This is more, I believe, than has ever been seen at one time by any other observer.

I am, Sir, truly yours,
Ashley Road, Bristol: WILLIAM F. DENNING,
December 1, 1870. Hon. Sec. Observing Astronomical Society.

STAR CATALOGUES.

Sir,—In addition to the information upon Star Catalogues given in your last by G. J. W., the following may perhaps be useful:—

Besides those two catalogues by Argelander, mentioned by G. J. W., there is another, containing 110,984 stars, situated between 2° south and 20° north declination; the epoch for the three catalogues is 1855. They were published at Bonn.

Argelander's *Northern Zone Observations*, 45° to 80°, have been reduced by Oeltzen, epoch 1842; Oeltzen's *Argelander* contains tables for precession. The work was published in Vienna.

Bessel's *Observations* have been reduced by Weisse, epoch 1825. Weisse's *Bessel*, 45° to 15 north declination, gives the precessions to the stars; W. B. north 15° to south 15° gives the precessions and secular variations; W. B. was published in Petersburg.

Argelander's 199 *Southern Zones*, containing 17,600 stars, from 15° to 31° south declination, are in one quarto volume of his partially reduced observations, and the observations require further reduction, which may be very easily done by the use of the tables on the same pages as the observations, together with some small tables (12mo.—99 pages) prepared for these observations. Published at Bonn.

The observations have been completely reduced, and rendered more convenient, by Oeltzen, who also has given tables for precession. O.A. southern zones must, however, be sought for in 6 parts (1857–8) of the *Sitzungsberichte der Kaiserlichen Akademie*, &c. (published in Vienna), 1,780 pages in all, of which O. A. takes up 444 pages. The epoch for these stars is 1850.

For stars within 9° of the North Pole, Carrington's *Redhill Catalogue of 3,735 Circumpolar Stars* (epoch 1855) is very valuable; it contains, besides much other matter, the numbers &c. necessary for calculating the precessions of the stars by Bessel's method. Published by Longmans.

Yours truly,
T. W.

THE AURORA OF OCTOBER 24th, 1870.

Sir,—In the various accounts which I have read of the grand auroral display of October 24th, I have not seen any mention made of the beautiful *triple arch* which formed, at one time, so conspicuous a feature of the phenomenon. The following extracts from my journal may therefore prove interesting to those who had not the opportunity of watching the remarkable changes which occurred. At 6h. 30′ P.M., I observed a strong auroral light over the whole northern sky. At 7·15 P.M. a very wide arch extended from the horizon, just below Capella, and passing between Ursa Major and Polaris, reached the western horizon and enveloped Corona Borealis. At the same time an arch of white auroral light extended from the western part of Aquila, and, passing below the square of Andromeda, Aries, and the Pleiades, reached as far as Aldebaran. This arch lasted only a few minutes. At 7·55 a magnificent carmine streamer, having on its western margin a narrow bluish one, darted up from the eastern extremity of the northern arch to Capella, and in a few moments extended itself nearly to the zenith. At 7·58 innumerable and beautiful streamers of a greenish colour darted up from the entire length of the northern arch, and various patches of carmine cloud appeared to the westward. At 7·59 a brilliant carmine canopy appeared over the zenith, and the southern arch, first seen at 7h. 15′, re-appeared. At 8·5 two more arches of white auroral light appeared suddenly below the aforesaid arch, each about 2° wide, and the same distance the one from the other; the whole forming a *magnificent triple arch*, situated to the south of the zenith of my observatory, and which doubtless formed that portion of the aurora which was seen in Italy and Malta. The two southerly arches did not continue more than three minutes, and never re-appeared. At 8·10 Jupiter, Auriga, Perseus, Aries, Cassiopeia, Draco, Lyra, and Aquila, were enveloped in one large and splendid carmine cloud. At 8h. 12′ the brilliancy had somewhat diminished, but there were still fine streamers, of a somewhat carmine colour and conical form, darting up towards the zenith from the whole horizon (ENE. by N. to WSW.) At 8·15 there were patches of carmine cloud in NE., NW., and SW., and a magnificent carmine arch extended from Jupiter through Taurus, Aries, Andromeda, and Aquila to a mass of pink aurora in WSW. This arch was the most northern of the triple arch mentioned above. At 8·17 this arch suddenly lost its carmine colour and became white, and slightly broken at its greatest convexity. At 8h. 25′ it became perfect again, and assumed its former pink colour. About this time there was a pinkish glow over the whole northern sky. At 8 28 a low white arch appeared beneath Ursa Major. At 8·30 aurora much diminished everywhere, with the exception of that portion in Auriga, Perseus, Taurus, and Aries, from which some white streamers projected into Andromeda. At 8·35 some carmine streamers appeared in Auriga, and a very white cloud in Andromeda, which lasted only a minute. At 8·41 two small detached portions of aurora, the one pink and the other white, each about one degree wide and five long, arranged themselves at right angles, the one to the other, near γ Andromeda; the former lying horizontally E. and W., the latter vertically N. and S. At 8·43 the aurora was still more diminished in brilliancy. At 9h. there was a strong white auroral light in the north, from which numerous streamers from time to time appeared, but the whole gradually drifted away to the NW., and at 10h. 15′ had disappeared.

The Aurora of October 25th was very inferior to that of 24th, but it was remarkable that the splendid auroral arch which extended several times from ENE. to WSW. on 24th, appeared and disappeared several times on the evening of 25th also, and exhibited, momentarily, very similar tints.

Yours obediently,

C. L. PRINCE.

Observatory, Uckfield:
January 3, 1871.

A REMARKABLE METEOR.

Sir,—If you have not received further accounts of a remarkable meteor, of which I only partially obtained a glimpse on Monday, January 9th, you will perhaps deem this notice worthy of insertion in the pages of the *Astronomical Register*.

1871, Jan. 9d. 10h. 10m. G. M. T., while directing telescope to the constellation of Orion, I was startled by a glare of light in the observatory, and on quickly moving to the slit, I saw a splendid cluster of meteors pass rapidly across that constellation from east to west, in a line nearly parallel to the equator, about half way between the belt and shoulders.

I should think that the meteor was visible for five seconds, of which I only saw it during the two last; it left a broad short train, which faded away in about three more seconds.

The meteor consisted of detached portions, making up a globular cluster of about the apparent size of the moon. In that space I estimate roughly that there were 8 to 12 separate meteorites.

The sky was clear, and the moon (just three days past the full) very bright, and I estimate the light of the meteor to have been about 1½ times that of the moon; its colour was nearly that of the mercurial electric light.

I am, Sir, your obedient servant,

R. C. JOHNSON.

Warrenside, Blundellsands, Liverpool.

Sir,—On the evening of the 9th of January, about 10 o'clock P.M., the night being remarkably clear, and the moon shining with great splendour, I saw one of the finest meteors I ever saw in my life; had the night been dark I believe it would have illuminated the whole heavens. It appeared near Beta Cassiopeiæ, and disappeared near the 5th mag. star Theta Andromedæ. Time of flight about 4 seconds—course straight.

Yours most respectfully,

Wolverhampton. HENRY SQUIRE.

MOCK MOONS.

Sir,—On Sunday evening last, while returning with a friend from Lawrence St. Lydeard to Wiveliscombe—the sky was partially covered with light fleecy clouds, and a ring or halo was formed around the moon, about 50° in diameter; the lower part was obscured by a bank of clouds—I saw two mock-moons or paraselenæ appear on the halo to the north and south of the moon. The sides towards the moon were of a light orange colour, and whitish beams of light shot out from them in an opposite direction. It was freezing at the time. This phenomenon lasted about twenty minutes. On arriving in the town I learnt that the same had been witnessed by persons there. As a subscriber to the *Astronomical Register*, I have thought that this may interest some of your readers. I should feel obliged if some kind reader would inform me of a work giving an account of such a phenomenon being seen in *this country*.

Yours respectfully,

Wiveliscombe, Somerset: Jan. 12. J. WEBB.

RECENT CHANGES IN JUPITER.

Previous to the 25th of last November, the *North Temperate* belt of Webb [*Pop. Sci. Review*, April 1870], or Mr. Gledhill's No. 2 [*Ast. Register*, April 1870], seemed to me remarkably persistent in its features; but on that night it exhibited two dark patches not previously seen. From this to the night of December 22 I was not able to observe; but then, after the planet had made 65 revolutions on his axis, the spots appeared again in the same position. On both occasions Webb's *South Sub-Torrid* belt (Gledhill's No. 5) was incomplete toward the west. This latter belt showed two similar patches or protuberances, chiefly projecting toward the south, on January 10, at 11h. 30m. G. M. T., and, an hour-and-a-half afterwards, a third became visible to the east of the others, which had now advanced considerably toward the limb, and, I think, a bright spot separated it from its neighbour. I never remarked any spots on this belt previously.

On November 25, at 10h. 25m., I saw a large dark spot, also new to me, on Webb's *South Temperate* belt (Gledhill's No. 6), No. 5 being at the same time incomplete toward the east.

Without being able to detect, with my very inferior means, the more minute features described in the last *Register* by Mr. Gledhill, I am glad still to be able to confirm in a general way his observations of recent changes in the appearance of Jupiter; and the three spots on his No. 5 belt, seen by me on January 10, and not alluded to by him, may be instances of further change developed since his communication.

J. BIRMINGHAM.

Millbrook, Tuam:
Jan. 12, 1871.

EPSILON LYRÆ.

Sir,—Amongst the many stellar objects with which astronomers are familiar, there are probably none more interesting than the beautiful group known as ε Lyræ. Even in an instrument of less than three inches aperture, when properly separated by adequate power, they present a spectacle to which the observer ever returns with a keener appreciation of its unique simplicity and grandeur. It is, however, the minute points of light in the immediate vicinity of this group which renders it of value to the practical observer, offering, as it does, several excellent tests for the light-gathering powers of large instruments.

Having devoted a considerable time last summer to observations of this group, with especial reference to its more minute members, I have obtained some estimate of their relative brilliancy, which may possibly be useful for comparison with the results obtained from more powerful instruments. The telescope I use is a refractor of 3-inches aperture, the object-glass being a very fine one by Browning, which bears readily a power of 300.

In the *Register*, Vol. 2, page 301, there is a communication from the late respected observer, Mr. Dawes, dealing with the whole group, and giving a diagram of them. The sketch shows the two doubles with the "debilissima" couple between them, and the brighter star following. Immediately in front, and a little to the south of the "debilissima," is another pair, and again, at a similar distance in front of these, a third pair. With 3·8 inches, Mr. Dawes had perceived the "debilissima" distinctly, also several very minute stars preceding them. Other observers had also perceived them, but with much larger apertures.

The first time I observed this group was with an inferior 3-inch glass, in May 1869, being at that time quite unaware of the existence of any other stars in this group besides the doubles. On this occasion I at once glimpsed the southernmost of the "debilissima," and after a time also saw the other one, and made a sketch of them. This sketch was afterwards compared, by a friend, with the one by Mr. Dawes referred to, and was pronounced identical with it, as far as the two stars were concerned. Observing the group again in March 1870 with the improved 3-inch glass, I glimpsed, in addition to the "debilissima," a minute star S. p. them, and considerably to the north of these another, immediately preceding E^1. These two stars formed a trapezium with E^1 and E^2. In May, the star just referred to as "immediately p. $E.^1$" was *steadily seen* on all occasions; indeed, although, of course, not so bright, it yet was quite as easily seen as the 9th mag. star *f* the group. It is readily found, from the fact that it forms a right-angled triangle with E^1 and E^2. The comes S. p., the southernmost of the "debilissima," was also glimpsed frequently. On these occasions I became aware of the existence of two other stars, which from their proximity to the group may, I think, be legitimately termed a fourth pair. They are situate immediately to the north of the northernmost of the third pair, and at almost the same angle and distance apart as the "debilissima," but are rather brighter.

To sum up the whole group as observed upon these several occasions, I think that I may safely put them in the following order of brilliancy, calling the various pairs in their order of distance, from a line joining E^1 and E^2, No. 1 (the "debilissima"), No. 2, No. 3, and No. 4 (the new pair).

The most visible object is the 9th mag. star *f*. The next most readily seen is the northernmost of pair No. 3, which, as I before remarked, forms a right-angled triangle with E^1 and E^2, and was readily seen on all occasions, being apparently about the 10th mag. The next in order of brilliancy is, I think, the new pair, No. 4, whose magnitudes are pretty nearly equal, and probably about 10·5 or 11. After these, the next easiest is decidedly the preceding one of the "debilissima," its companion being a little more feeble in lustre. Webb gives them both 13th mag., but the *p.* one is certainly brighter than this. I think we may safely put down the southernmost of pair No. 2 as the next most difficult, as I could only glimpse this on rare occasions, whilst the northernmost of No. 2 pair, and the southernmost of No. 3, have always been beyond my eye and instrument.

From a consideration of these facts (which have only been noted down after many careful observations), it would seem as though some of the objects had brightened somewhat since the time when even the "debilissima" resisted Herschel's 5-inch achromatic. A perfect knowledge, however, of the situation of the companions (although I had not this aid when I picked up the "debilissima") may have rendered some of the objects easier.

I trust that some other observers will communicate the results obtained by the use of large apertures, as they would be useful for comparison, and also serve to show whether I have placed the members of this group in their proper order of brilliancy.

I remain, yours faithfully,
ALBERT P. HOLDEN.

Hoxton Street, N.: Jan. 7, 1871.

OCCULTATION OF URANUS.—On Friday, February the 3rd, an occultation of Uranus will take place at 6h. 14m. The planet will reappear at 6h. 57m.

THE GREAT MELBOURNE EQUATORIAL.—We have received from M. Grubb a pamphlet, in reply to the charges made against this instrument. The crowded state of our pages prevents us giving extracts, but we shall do so as soon as space permits.

PRIVATE OBSERVATORIES. — A valued correspondent writes: "Would not something, in pursuance of the suggestion by T. G. R., given in the *Register*, No. 88, be likely to interest many of its readers? A direct re-appeal to its subscribers might be likely to elicit a large proportion of the requisite information. I cannot but believe that if a *direct* request were made, with particulars desired, and a limited time named within which the return should be forwarded, that it would be very generally responded to, and that owners of observatories, who may not be subscribers to the *Astronomical Register*, would be equally willing to furnish the small amount of information required, if the request could be brought under their notice." T. W. [We received but few replies to our last request on this subject; but when our pages are a little less occupied we will give special attention to the matter, and trust to be able to produce a tolerably faithful list of private observatories.—ED.]

THE SUN.—M. Gauthier-Villars, the scientific publisher, has completed the publication of Father Secchi's work on the Sun. It comprises more than four hundred octavo pages, and will certainly be largely circulated when Paris is open. Father Secchi has written it in French, having secured the assistance of some learned Jesuits. It is not, however, merely a translation of his former Italian work on the same subject.

Owing to a misapprehension, the paper on the Astral Heavens was not properly corrected. We submit the following errata:—Page 290, line 15 from bottom, for *jeub* read *jenb*; page 291, line 11 from bottom, for Trontenelli read Fontenelle; line 12, for Canobas read Canobos; line 15 from bottom, for make read move; line 21, for Saggitarius read Sagittarius; line 27, for Nabis read Navis; page 292, line 8, for Harbrœllianum read Hartwellianum; line 14, for might read would; page 299, line 14 from bottom, for practical read practised.

ASTRONOMICAL OCCURRENCES FOR FEB. 1871.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Wed	1		Sidereal Time at Mean Noon, 20h. 45m. 0·30	2nd Tr. I. „ Sh. E. „ Tr. E. „ Sh. E. 1st Tr. I. „ Sh. I.	7 22 9 29 10 0 12 10 13 25 14 30	Moon — 9 12·5
Thur	2			1st Oc. D. „ Ec. R. 3rd Tr. I.	10 34 13 53 39 14 52	10 3·7
Fri	3	6 14 6 57 7 35	Occultation of Uranus Reappearance of ditto Conjunction of Moon and Uranus, 0° 43′ S.	2nd Ec. R. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	7 5 14 7 52 8 59 10 7 11 14	10 55·9
Sat	4		Meridian Passage of the Sun, 14m. 10s. after Mean Noon	1st Oc. D. „ Ec. R.	5 2 8 22 32	11 48·4
Sun	5	2 1	○ Full Moon	1st Sh. E.	5 43	12 40·3
Mon	6			3rd Oc. R. „ Ec. D. „ Ec. R. 2nd Oc. D.	7 16 9 18 35 11 52 13 15 29	Jupiter — 7 55·1
Tues	7					7 51·1
Wed	8	20 17	Conjunction of Moon and Mars, 1° 55′ S.	2nd Tr. I. „ Sh. I. „ Tr. E. „ Sh. E. 1st Tr. I.	9 50 12 7 12 28 14 49 15 15	7 47·2
Thur	9			1st Oc. D. „ Ec. R.	12 25 15 49	7 43·2
Fri	10			2nd Ec. R. 1st Tr. I. „ Sh. I. „ Tr. E. „ Sh. E.	9 40 56 9 43 10 54 11 58 13 9	7 39·3
Sat	11		Saturn's Ring: Major Axis = 35″·0 Minor Axis = 15″·2	1st Oc. D. „ Ec. R.	6 53 10 18 14	7 35·4
Sun	12	3 0	☾ Moon's Last Quarter	1st Sh. I. „ Tr. E. „ Sh. E.	5 23 6 25 7 38	7 31·5
Mon	13			3rd Oc. D. „ Oc. R. „ Ec. D.	8 20 11 0 13 18 59	7 27·6
Tues	14	17 25 18 24	Occultation of B.A.C. 6161 Reappearance of ditto Illuminated portion of disk of Venus = 0·962 of Mars = 0·958			7 23·7
Wed	15	4 40	Conjunction of Moon and Saturn, 0° 36′ N.	2nd Tr. I. „ Sh. I. „ Tr. E.	12 20 14 45 14 59	7 19·8

DATE		Principal Occurrences h. m.		Jupiter's Satellites	h. m. s.	Meridian Passage h. m. Jupiter
Thur	16		Sidereal Time at Mean Noon, 21h. 44m. 8·62	1st. Oc. D.	14 17	7 16·0
Fri	17	1 20	Conjunction of Moon and Mercury, 1° 35′ N.	3rd Sh. E. 2nd Oc. D. 1st Tr. I. 2nd Ec. R. 1st Sh. I. „ Tr. E. „ Sh. E.	6 3 7 11 11 34 12 16 37 12 49 13 49 15 5	7 12·2
Sat	18		Meridian passage of the Sun, 14m. 10s. after Mean Noon	1st Oc. D. „ Ec. R.	8 45 12 14 1	7 8·4
Sun	19	1 48	● New Moon	1st Tr. I. 2nd Sh. E. 1st Sh. I. „ Tr. E. „ Sh. E.	6 2 6 46 7 17 8 17 9 33	7 4·6
Mon	20	9 40	Conjunction of Moon and Venus	1st Ec. R. 3rd Oc. D. „ Ec. R.	6 43 1 12 8 14 49	7 0·8
Tues	21					6 57·0
Wed	22			2nd Tr. I.	14 53	6 53·2
Thur	23					6 49·5
Fri	24			3rd Sh. I. 2nd Oc. D. 3rd Sh. E. 1st Tr. I. „ Sh. I. 2nd Ec. R.	7 18 9 42 10 5 13 27 14 44 14 52 15	6 45·7
Sat	25			1st Oc. D. „ Ec. R.	10 39 14 9 50	6 42·0
Sun	26	22 38 9 17 10 23	☽ Moon's First Quarter Occultation of B.A.C. 1272 Reappearance of ditto	2nd Sh. I. „ Tr. E. 1st Tr. I. „ Sh. I. 2nd Sh. E. 1st Tr. E. „ Sh. E.	6 42 6 49 7 55 9 13 9 24 10 10 11 28	6 38·3
Mon	27	15 33	Conjunction of Moon and Jupiter	1st Ec. R.	8 38 50	Moon — 6 15·5
Tues	28					7 3·3

THE PLANETS FOR FEBRUARY.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	19 22 52	−20 0½	8″·0	22 34·2
	15th	20 16 54	20 7	6″·3	22 33·0
Venus	1st	21 52 59	−14 27	10″·0	1 7·8
	15th	22 59 24	8 1	10″·3	1 19·0
Mars	1st	12 34 1	−0 8½	12″·5	15 46·4
	15th	12 34 22	+0 7	14″·1	14 51·7
Jupiter	1st	5 1 34	+22 26	41″·1	8 15·2
	15th	5 1 15	+22 28	39″·3	7 19·8
Uranus	2nd	7 43 18	+21 53	4″·2	10 52·4
	14th	7 41 13	+21 58	4″·2	10 3·3
Neptune	2nd	1 13 59	+6 2½	—	4 24·3

Mercury passes the meridian about an hour and a half before noon on the 1st, the interval decreasing to the end of the month. It may therefore be well seen in the morning at beginning of the month.

Venus passes the meridian on the 1st more than an hour after noon, and by the end of the month an hour and a half. It will therefore be visible just after sunset.

Mars passes the meridian on the 1st, three hours and three quarters after midnight, and will be visible earlier each night following to the end of the month.

Jupiter may be observed through the greater part of the night, setting at the end of the month at a little before three o'clock in the morning.

Uranus is well situated for observation.

MOON'S TERMINATOR.

Selenographic longitudes, at which the Moon's Terminator passes the Lunar Equator and the parallels of 60° of northern and southern latitude.

Greenwich midnight		60° N.		0°		60° S.
		Sun's Centre Rising:				
		°		°		°
1871. Feb. 1	...	−50·1	...	−51·6	...	−53·2
2	...	62·2	...	63·8	...	65·3
3	...	74·3	...	75·9	...	77·5
4	...	−86·4	...	−88·0	...	−79·7

SUN'S CENTRE SETTING:

5	...	+78·2	...	+79·8	...	+81·5
6	...	66·0	...	67·7	...	69·4
7	...	53·8	...	55·6	...	57·3
8	...	41·7	...	43·4	...	45·2
9	...	29·5	...	31·3	...	33·1
10	...	17·3	...	19·1	...	21·0
11	...	+5·1	...	+7·0	...	+8·8
12	...	−7·1	...	−5·2	...	−3·3
13	...	19·3	...	17·4	...	15·4
14	...	31·5	...	29·5	...	27·6
15	...	43·7	...	41·7	...	39·7
16	...	56·0	...	53·9	...	51·9
17	...	−68·2	...	−66·1	...	−64·1

SUN'S CENTRE RISING:

20	...	+79·4	...	+77·3	...	+75·1
21	...	67·3	...	65·1	...	62·9
22	...	55·1	...	52·9	...	50·7
23	...	43·0	...	40·7	...	38·4
24	...	30·8	...	28·5	...	26·2
25	...	18·6	...	16·3	...	14·0
26	...	+6·5	...	+4·1	...	+1·8
27	...	−5·7	...	−8·0	...	−10·4
28	...	−17·8	...	−20·2	...	−22·6

ALGOL.

According to Professor Schoenfeld's Ephemeris, in *Astr. Nachr.*, No. 1,807, Algol will be at its minimum—

			h.	m.	
1871. Feb. 2	...	...	7	28	G. M. T.
5	...	...	4	17	,,
13	...	...	18	45	,,
16	...	...	15	34	,,
19	...	...	12	23	,,
22	...	...	9	13	,,
25	...	...	6	2	,,

THE GREAT AURORA.—It is announced that the diggers at the diamond-fields on the Vaal, South Africa, witnessed a brilliant display of the Aurora Australis on the nights of the 23rd and 24th of October. It will be remembered that the Aurora Borealis was singularly splendid in this country at that period, the most extraordinary display on the 24th of October having been specially noticed in this paper for its unusual character. It is very interesting to have now this accidental record of the simultaneous intensity of this electrical phenomenon at both the northern and southern poles of our planet.

NEW VARIABLE STAR.—M. Krüger, writing from Helsingfors under date of Dec. 15, 1870, announces the discovery of a new variable star, which he designates T Cassiopeiæ. Its position (1855) is RA. 15m. 25s., and Decl. + 54° 59·3′. The changes of magnitude appear to range from 7½ to 9.

DOUBLE STARS.—Observers of double and binary stars may like to know that Baron Dembowski is publishing, in the *Astronomische Nachrichten*, a series of recent measures of Shure's doubles. These will be found in the following numbers of the periodical in question:—1798, 1799, 1800, 1806, 1808, 1810, 1822, 1823, 1826, 1829, and 1830.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN FEBRUARY 1871.

By W. R. Birt, F.R.A.S.

Day	Supplement ☾ – ☉ Midnight		Objects to be observed
	°	′	
1	41	33	Sinus Iridum and region on the N.
2	30	18	Mare Imbrium, its dark border on the N.W.*
3	18	48	Pythagoras, Grimaldi Schickard.
4	7	1	Objects between the M. Crisium and the W. Limb.
21	150	37	Mare Crisium, craters and spots on its surface.
22	139	0	Cleomedes, line of eruption in the interior.
23	127	39	Atlas, Hercules, Guttemberg.
24	116	33	Lacus Mortis, Plana, Burg.
25	105	37	Aristoteles, Eudoxus, "Alexander." †
26	94	48	Hipparchus,‡ Triesnecker, Hyginus.§
27	83	58	Albategnius, Parrol, Airy.
28	73	5	Clavius, Terra Photographica.¶

After the full, the objects specified in January may be observed under the reversed light in the order in which they are mentioned.

The lunar season is between the autumnal equinox and winter solstice, N. hemisphere N. pole in darkness.

* Consult Monthly Notices R. A. S. Vol. xxiii. p. 224.

† The formation betweeen Eudoxus and the Mare Serenitatis has been named "Alexander" from its resemblance in some measure to the formation S. of Menelaus known as "Julius Cæsar." The two formations are nearly on the same meridian.

‡ Consult Monogram of Hipparchus for objects in the interior.

§ The Dorpat drawing by Mädler, on a large scale, of the Godin and Agrippa region, including the clefts of Triesnecker and Hyginus, annexed to the revised edition of the large map, may be consulted with advantage.

¶ Named to commemorate Mr. De la Rue's labours in celestial photography. The formation is west of Clavius.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.

Dallmeyer, J. H.
Davies, Lieut.
Glaisher, James
Metcalf, Rev. W. R.
Petty, T.
Prince, C. L.
Reside, J.

To March 1871.

Hemming, Rev. B. F.
Jackson-Gwilt, Mrs.
Ormesher, H.
Rivaz, Miss
Ryle, Rev. J. C.
Woodman, T. C.
Wright, W. H.

To June 1871.

Fleming, Rev. D.
Hubbersty, R. C.
Rump, H. R.
Sargent, Rev. J. P.

To July 1871.

Green, S.

To December 1871.

Bird, F.
Collingwood, E.
Davies, Rev. R. B.
Escombe, R.
Jones, Rev. E.
Lamb, W.
Lee, J.
Monk, Dr.
Perry, Rev. J. S.
Prout, Rev. E.
Redpath, H. S.
Richard, J. E.
Slugg, J. T.
Thompson, Prof.
Tidmarsh, Rev. J. B.
Waldegrave, Hon. H. N.
Warinner, H.
Wilson, T.

January 24, 1871. Subscriptions after this date in our next.

NOTICES TO CORRESPONDENTS.

We are obliged to postpone Mr. Grover's Notes on the Starry Heavens, also a paper by Lieutenant Davies upon a Loss of Intensity of Light, &c.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham, House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 99. MARCH. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Fourth Meeting, February 10, 1871.

The Annual General Meeting.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last annual meeting were read and confirmed. The Report of the Council, including that of the auditors, was presented and read. The number of Fellows and Associates is 554. The accounts were satisfactory, and full details of the stock of publications and the instruments belonging to the Society were given.

Part II. of Volume XXXVII., and Volume XXXVIII. of the *Memoirs*, have been published. They contain the following papers.

Volume XXXVII., Part II. :—

1. "On a Determination of the Direction of the Meridian with a Russian Diagonal Transit Instrument." By Capt. A. R. Clarke, R.E., F.R.S.

2. "A Determination of the Constant of Nutation from the Observations in N.P.D. of *Polaris*, *Cephei* 51, and δ *Ursæ Minoris*, made with the Transit-circle of the Royal Observatory, Greenwich, 1851-65." With an Addendum containing "A Determination of the Constant of Nutation from the Observations of *Polaris* in Right Ascension." By E. J. Stone, Esq., M.A., F.R.S.

Volume XXXVIII. :—

1. "Seventh Catalogue of Double Stars, observed at Slough in the years 1823-28 inclusive, with the 20-feet Reflector; 84 of which have not been previously described." By Sir J. F. W. Herschel, Bart., F.R.S.

2. "On the Determination of the Orbit of a Planet from Three Observations." By Professor Cayley, F.R.S.

An Index to the first 29 volumes of the *Monthly Notices* has been compiled by Mr. Williams, at the desire of the Council, and printed and presented to the Fellows of the Society. This is a most useful work.

The Society has to regret the loss by death of the following Fellows and Associates:—Fellows:—Prof. E. W. Brayley, Mr. C. Mason, Admiral Manners, Mr. H. Boys, Sir F. Pollock, Rev. Dr. Gwatkin, Mr. G. R. Smalley, Mr. J. G. Perry, Mr. C. D. Archibald, Mr. C. Frodsham, Colonel Sir W. T. Denison, Mr. H. Barrow. Associate:—Prof. H. Selander.

From the obituary notices we extract the following biography of the late President:—

Admiral Russell Henry Manners was born in London on the 31st of January 1800, entered the Royal Naval College the 6th of May 1813, and embarked March the 6th, 1816, as a volunteer on board the *Minden*, 74, Captain Paterson; in which, after assisting at the bombardment of Algiers, he proceeded to the East Indies, where he served under the flag of Sir Richard King, until nominated midshipman, the 1st of July 1818, to the *Orlando*, 36, commanded by Captain John Clavell, with whom, in 1819, he returned to England on the *Malabar*, 74. After an intermediate employment on the Channel and West India stations in the *Spartan* and *Pyramus* frigates, under Captains W. Furlong Wise and Francis Newcombe, he became, the 29th of July 1822, Acting Lieutenant of the *Tyne*, 26, Captain John Edward Walcot, to which vessel the Admiralty confirmed him the 19th of October following. In May 1823 he rejoined the *Pyramus*, still commanded by Captain Newcombe, under whom he continued until he obtained his promotion on the 16th of August 1825. His last appointment was on the 21st of October 1827, to the command of the *Britomart*, 10. The *Britomart* was first employed and intended for the Channel service under the order of the Commander-in-Chief, the Earl of Northesk, at Plymouth. She accompanied the squadron of ships escorting Don Miguel to Lisbon in the early part of 1828. In consequence of the revolution that followed in Portugal on Don Miguel declaring himself absolute, the *Britomart* was stationed at and off Oporto to watch the British interests there. The zeal and ability with which this service was carried out by Captain Manners, as witnessed by Sir George Sartorius, there in command of the Portuguese Constitutional Squadron, and under whose orders in some degree the *Britomart* was placed, led to Captain Manners receiving his Post-rank on the 4th of March 1829. He retired from active service in March 1849, became Rear-Admiral in July 1855, Vice-Admiral in April 1862, and Admiral in September 1865.

Admiral Manners was the only child of the late Mr. Russell Manners, M.P., and married, in 1834, Louisa Jane, daughter of Count de Noé, peer of France, who survives him, and by whom he has two sons and a daughter.

From the time he attained his Post-rank to the time of his death he devoted himself to scientific pursuits. He was elected a member of the Royal Astronomical Society in 1836. At a very early period he took an active interest in its administration, and, after being on the Council for some time, was elected one of the honorary secretaries in February 1848—an office which he filled until 1858, when he accepted that of Foreign Secretary. This was a post for which his knowledge of foreign languages and his position in society peculiarly fitted him; and during his tenure of office he formed, by active correspondence, a connecting link between English and foreign astronomers.

Admiral Manners was, on more than one occasion, asked to accept the chair of President, which, after some hesitation, he consented to do and he was elected to that position in 1868. None of his predecessors were more highly esteemed by the Fellows of the Society, and no one filled the chair more admirably than he did. His mathematical attainments were considerable—more so than one might be apt to infer from his quiet demeanour. He was well versed in the astronomical literature of the day, and took a deep interest in the progress of astronomical science, both in England and on the Continent; and his active influence was always available for the promotion of any object connected with it.

On presenting the gold medal of the Society to Mr. Stone, first assistant of the Royal Observatory, Greenwich, Admiral Manners delivered a most able and exhaustive summary of that able astronomer's labours, and evinced a complete knowledge of the history of the solar parallax, for the investigation of which the medal was mainly awarded. Illness overtook him before he could complete his second year of office, and he was compelled to forego the gratification of delivering the address to M. Delaunay for his researches on the lunar theory; but he made it a point of duty and pleasure to receive M. Delaunay at his house; and although he was compelled to delegate to the friendly hand of Prof. Adams the drawing up of the address, yet he read and approved of what was written before it was delivered.

Admiral Manners, in all his relations, was a pure-minded, courteous, and sympathetic man, and in the fullest sense of the word a gentleman.

At the Royal Observatory, Greenwich, the usual work has been carried on. The Sun, Moon, and Planets have been observed with the Transit Circle, and the Moon with the Altazimuth. In consequence of the siege of Paris, the observations of the small planets had to be carried on during the whole lunation, instead of only half as usual. Observations of the Solar Eclipse of December 22 were made with the great Equatorial and Altazimuth, for correcting the tabular places and semi-diameters of the Sun and Moon, and ascertaining the amount of irradiation. A gradual subsidence of the eastern pier of the Transit Circle having taken place, a sheet of writing paper, $\frac{1}{270}$th of an inch thick, was placed under the Y, which produced the desired correction. The new 7-year Catalogue, 1861–1867, has been printed and distributed, and will be found of great value to astronomers.

At Cambridge the new Transit Circle due to the munificence of Miss Sheepshanks has been mounted, and is now undergoing examination and adjustment. The Radcliffe Observatory, Oxford, has lost a valuable assistant, Mr. Bechaux, by death. The volume of observations for 1867, including a catalogue of 1,772 stars, has been printed and published, and the heliometer has been provided with a solar eye-piece, in which the light is diminished by polarising prisms. At Stonyhurst, great improvements and additions have been made in the spectroscopic and meteorological departments. Double stars have been measured, the solar lines and prominences observed, and comets and meteors watched.

With respect to the general progress of Astronomy the Report remarks:—

The progress of Astronomy, in common with that of every other science, has been seriously affected by the terrible war, which has so largely absorbed the attention of all classes since July 1870. We have been influenced by it in England, but in France and Germany scientific progress has been greatly interrupted. Even before the completion, in September last, of the great cordon of troops and artillery which has shut off Paris from the rest of the world, the effects of war on science were shown by the reduced size of the *Comptes Rendus*, and the disappearance of some French scientific journals. In Germany, many young astronomers of great promise, not altogether unknown in this country, exchanged the observatory for the battle-field, where some, alas! have fallen.

But notwithstanding these unfavourable circumstances, the year just closed has not been barren of discoveries. Three planets, hitherto unrecognised, have been added to the known members of the solar system; four comets have been detected, some even in Germany at no great distance from the scene of war; and an increase to our knowledge of the constitution of the Sun has been undoubtedly obtained from the recent Solar Eclipse, to observe which, two of the greatest astronomical expeditions of modern times were organised and despatched from this country and America to Sicily, Cadiz, Gibraltar, and Oran. In our own Society the evening meetings have been well attended, at which important papers have been read and freely discussed.

The Report then details the fitting out and organisation of the Expeditions for observing the total Solar Eclipse of Dec. 22, 1870, and proceeds thus:—

The present time is too early for a complete analysis of the different observations with a view of eliciting from them the new teaching which they may contain of the extent and nature of the coronal light, still it may not be undesirable to give a short account of some of the more important observations.

In the last Annual Report, in the account of the Eclipse of August 1869, attention was called to the two apparently distinct portions besides the prominences in the light seen round the Moon during totality. The American pictures showed similar indications of brighter portions near the Sun's limb, within which the eruptions of hydrogen forming the prominences take place, to those which were visible in the photographs taken by Mr. De la Rue in 1860, and by Tennant and Vogel in 1868. A distinction between different portions of the coronal light was observed as early as 1706 by MM. Plantade and Capiés at Montpelier. "As soon as the Sun was eclipsed there appeared around the Moon a very white light forming a corona, the breadth of which was equal to about 3′. Within these limits the light was everywhere equally vivid, but beyond the exterior contour it was less intense and was seen to fade off gradually into the surrounding darkness, forming an annulus around the Moon of about 8′ in diameter." In 1842 M. Arago considered this distinction to be sufficiently marked to sanction the subdivision of the corona into two concentric zones, the inner zone equally bright and well defined at the outer border, while the exterior zone gradually diminished in brightness until it was lost in the surrounding darkness.

The observations of the eclipse of last December confirm these earlier descriptions as to the apparent subdivision of the coronal light, though the breadth of the inner zone varies considerably as described by different observers. In our future remarks we shall restrict the word *corona* to the inner brighter ring, and for the faint exterior portion use the term *halo.*

It may conduce to clearness in our interpretation of those observations which appear to differ from each other, if we consider that the imperfect transparency of our atmosphere must cause a scattering of a portion of the light of the corona seen through it, and form a more or less brightly illuminated screen between the eye and the eclipsed sun. The atmospheric light will interfere especially with the observer's appreciation of the form and extent of the faint halo. There may exist at least three distinct sources of the light seen about the sun, in addition to the prominences, the corona, a solar halo overlapping the corona or beginning at its exterior limit, and an atmospheric halo produced by the scattering of the light by our atmosphere. The corona and solar halo would probably not alter greatly in the short time between observations of the same eclipse at different stations, but the scattering light would be peculiar to each station, and be mixed up with the effect of haze or light cloud present at the time. It is *possible* that without the earth's atmosphere some scattering of light may arise from the imperfect transparency of interplanetary space, not to speak of the possible existence of finely divided matter most densely aggregated around the sun. It may be that in these and some other considerations will be found the key to the interpretation of the widely different descriptions of the solar surroundings which come to us from different observers.

Prof. Watson, observing at Carlentini, describes a bright corona about 5′ high; observations at Cadiz give a breadth of about 3′; Lieut. Brown, observing with Lord Lindsay, found the inner zone, which he saw defined at its outer margin, to vary from 2′ to 5′ in breadth. Mr. Abbott, at Gibraltar, makes it about 5′ high. Some of the observers describe the exterior contour of the corona to be affected by the prominences, bulging out over the loftiest of these. In the photographs a defined corona is also seen,—in Lord Lindsay's photographs and the one taken by Mr. Willard, it extends rather more than 1′. In the photograph by Mr. Brothers the height of the brighter zone varies from 3′ to 5′.

We will now speak of the photographs of the totality, which are very instructive.

The photographs taken at Cadiz by Lord Lindsay were obtained by placing the sensitive surface at the focus of a silvered glass mirror 12½ inches in diameter and 6 feet focal length, giving an image of the sun about ¾-inch in diameter. The other photograph taken near Cadiz by Mr. Willard of the American expedition was obtained at the focus of an achromatic object-glass of 6 inches diameter, specially corrected for actinic rays.

Mr. Brothers, at Syracuse, employed a photographic object-glass of 30-inches focal length and 4 inches diameter, lent to him by the maker, Mr. Dallmeyer. This lens gave a brilliant image of the sun about three-tenths of an inch in diameter, which was received upon a plate 5 inches square. The camera was mounted on the Sheepshanks equatorial, belonging to the Society.

The photograph taken at the commencement of totality by Lord Lindsay had an exposure of twenty seconds. It shows around the Moon's advancing limb a bright corona extending about 1′ from the Moon's limb, in which the prominences are distinctly marked. Outside this a halo of faint light diminishing rapidly in brilliancy with indications of a radial structure which can be traced as far as 15′ from the Moon's limb. On the other side of the Moon, where it overlaps the Sun sufficiently to conceal the prominences and the bright corona, *the halo is almost absent.* It may be suggested that such portion of the halo as appears around the advancing limb of the Moon has its origin on this side of the Moon. As a pure speculation the explanation may perhaps be hazarded, that the true solar halo, as some spectroscopic observations would suggest, was less powerfully actinic than the scattered light of the prominences and corona, in which the halo on the one side of the Moon only as seen on the plate may have its origin.

The photograph taken by Mr. Willard was exposed during a minute and a half, and therefore must contain mixed up several successive appearances. The prominences are distinctly shown, and a defined corona of rather more than 1′ in height. In the halo there are indications of portions of unequal brightness, and a radial structure, but the most remarkable feature is a V-shaped rift or dark space, in the halo on the south-east, beginning from the outer boundary of the bright corona; a second similar dark space is faintly traceable on the south. The same dark gaps are also recorded in an eye-sketch by Lieut. Brown. Similar dark rifts are also shown in Mr. Brothers' photograph taken at Syracuse. The photograph taken by Mr. Brothers is very valuable, since it shows the halo extending towards the north-east, about two diameters of the Moon, and on the east and south about one diameter; the halo, therefore, is not concentric with either the Sun or Moon, but extends to the greatest distance in the direction from which the Moon is moving. It shows in many parts traces of a radial structure. The stronger light about the Moon is much broader on the west and north, and assumes a somewhat stellate appearance with rays gradually softening down as if combed out into the fainter halo. This photograph was taken in nine seconds, and therefore presents a true representation of the different phenomena at the time, that is, so far as their relative actinic power, which may possibly differ in a sensible degree from the relative brightness they present to the eye. The eye-sketches made at different stations show remarkable differences, especially in the form of the outer part of the halo: some represent it as consisting of separate rays, others give to it an almost true geometrical contour; in some of the Spanish sketches a tendency to assume roughly a quadrangular form can be detected, while in most of the Sicilian drawings there is a tendency to an annular form.

We pass to the spectroscopic results of the corona and halo.

Prof. Winlock, using a spectroscope of two prisms on a five and a half inch achromatic, found a faint continuous spectrum. Of the bright lines, the most persistent was 1474 Kirchhoff. This bright line, and the continuous spectrum without dark lines, were followed from the Sun to at least 20′ from his disc. Prof. Young estimates the least extension of this line to a solar radius.

Capt. Maclear, observing with a direct-vision spectroscope attached to a four-inch telescope, saw a faint continuous spectrum and bright lines in positions about C D E and F to a distance of 8′ from the Moon's limb, and also the same lines, but much fainter, *on the Moon's disc*. This observation would seem to show, as has been already suggested, that some of the light from the true surroundings of the Sun is scattered by some medium between the eye and the Moon, and therefore the distance from the Moon to which these lines can be traced does not imply necessarily an equally great extension of the true halo.

Lieut. Brown, of Lord Lindsay's party, saw only a continuous spectrum without bright lines. Mr. Carpmael, observing at Estepona, saw three bright lines in the spectrum of the corona. He considers the one in the green to correspond with 1359 Kirchhoff.

The observations with the polariscope show that a portion of the coronal light is polarised; and though the results as to the plane of polarisation are interpreted differently by different observers, there seems reason to suppose with Mr. Ranyard that the light is polarised radially, showing that the corona and halo may possibly reflect solar light as well as emit light of their own.

There is one observation made by Prof. Young which is of so much importance that it will be well to give an account of it in Prof. Langley's words:—

"With the slit of his spectroscope placed longitudinally at the moment of obscuration, and for one or two seconds later, the field of the instrument was filled with bright lines. As far as could be judged, during this brief interval every non-atmospheric line of the solar spectrum showed bright; an interesting observation confirmed by Mr. Pye, a young gentleman whose voluntary aid proved of much service. From the concurrence of these independent observations we seem to be justified in assuming the probable existence of an envelope surrounding the photosphere, and beneath the chromosphere, usually so called, whose thickness must be limited to two or three seconds of arc, and which gives a discontinuous spectrum consisting of all, or nearly all, the Fraunhofer lines showing them, that is, *bright* on a dark ground."

Rapid and imperfect as this early sketch must necessarily be of the observations of the last eclipse, it shows a distinct and important gain to our knowledge of solar physics.

Some extremely valuable results, due to the researches of Physicists in Spectrum Analysis, are then adverted to:—

In the winter 1867–8 Angström found the light of the auroral arc to be nearly monochromatic, giving in its spectrum a single brilliant line in the green near the group of calcium lines, and traces of three feeble bands near F. This observation was confirmed by Struve. In 1869 Professor Winlock observed five bright lines in the green and blue parts of the auroral spectrum.

During the past year a brilliant line in the red portion of the spectrum has been detected in some parts of the auroral display. This line was observed first by Mr. Ellery, at Melbourne, on April 5, 1870.

On October 25 Zöllner compared the position of the red line with the lines of lithium and sodium. From the position of the auroral lines relatively to these, he considers that it falls in the spectrum very nearly where a group of atmospheric lines occurs in the solar spectrum, having a mean wave-length of 0·0006279. Zöllner suggests that this auroral spectrum, which does not correspond with any known spectrum of the gases of the atmosphere, may be a spectrum of one or more of these gases of an order we have not yet been able to obtain experimentally, since we can only have to do with thin strata of gas, whereas the auroral light may come from an enormously thick layer of one or more of the gases of the atmosphere at a relatively low temperature.

Mr. Lockyer, in continuation of his important researches on Solar Physics, considers that he has now evidence, from the different behaviour of the line C and the line near D, that the latter does not belong to hydrogen—a result in harmony with the absence of the line near D, from the different spectra of hydrogen obtained experimentally.

His observations show, he believes, that prominences may be divided into two classes—those in which great action is going on and lower vapours injected, and those which are tranquil so far as wave-length goes, which are usually high, bright, and persistent.

While observing a solar spot with the spectroscope, on April 16, Mr.

Lockyer saw "the whole prominence spectrum was built up of single discharges shot out from the region near the limb, with a velocity sometimes amounting to a hundred miles in a second. On the following day, using a tangential slit, he found in the spectrum of the base of the prominence hundreds of the Fraunhofer lines beautifully bright." Mr. Lockyer considers that he has evidence that at the present maximum period of sun-spots not only is the region of a spot comprised by the penumbra, but the chromosphere also is shallower than in the year 1868.

Prof. C. A. Young has succeeded, by means of a spectroscope having a dispersive power of thirteen prisms of heavy flint each with an angle of 55°, attached to an achromatic telescope of 6·4-inches aperture, and 9 feet focal length, in obtaining photographs of the solar prominences. Negatives have been made which show clearly the presence and general form of the protuberances, but at present the definition of details is unsatisfactory. The hydrogen line γ (2,796 of Kirchhoff), though very faint to the eye, was found to be decidedly superior to F in actinic power.

Professor Respighi has done good service in the same field of research by mapping all the prominences which appear around the sun from day to day, and arranging them for each day in a straight line, so that the appearances for different days by being placed under each other admit of easy comparison.

Valuable additions have been made during the past year to the apparatus employed in spectroscopic research. The most important of these, doubtless, are improved methods by which the prisms of a spectroscope can be brought automatically to the position of minimum deviation for any part of the spectrum to which the observing telescope is directed.

Independent methods by which this important addition to the spectroscope has been successfully accomplished are described by Mr. Browning and Mr. Grubb, and valuable suggestions contained in a paper by Mr. Proctor. Ingenious apparatus for recording the lines seen have also been devised.

Three minor planets have been discovered within the last twelve months, *Lydia* (110) at Marseilles, by M. Borelly, on April 19; *Ate* (111) at Hamilton College, Clinton, New York, by Dr. C. H. F. Peters, on August 14; and *Iphigenia* (112) also by Dr. C. H. F. Peters, on September 19.

The following comets have been under observation since the date of the last Report. Three of them were detected by Dr. Winnecke. Comet I. 1870, discovered by Dr. Winnecke, at Carlsruhe, on May 29; Comet II. 1870, discovered by M. Coggia, at Marseilles, on August 28; Comet III. 1870 (Periodic Comet of D'Arrest), detected by Dr. Winnecke, on August 31; Comet IV. 1870, discovered by Dr. Winnecke, on November 23.

The Report then proceeds to give interesting notices of the new Zenith Sector, for the Indian Survey, constructed from the design of Colonel Strange, and most favourably reported on by Captain Herschel. It commends Professor Cayley's paper on the Graphical Construction of a Solar Eclipse, and Mr. Proctor's excellent Star Atlas, and his papers on the Distribution and

Distances of the Fixed Stars. The report narrates Dr. Brünnow's observations at Dunsink, Ireland, with the great *South* refractor, especially his researches on the parallax of α Lyræ and 61 σ Draconis, the former star giving $0''\cdot214$, and the latter $0''\cdot255$; and concludes with an account of Lord Rosse's further experiments on the heat of the Moon, and Mr. Browning's description of changes of colour on the belts of Jupiter.

The President's Address.

Mr. Lassell stated that no medal had been awarded this year, but that it must not be inferred from this that there were no astronomers worthy of such a reward, but rather the reverse. The fact was, that recently one science had become so dependent on others that it frequently happened two or more persons were associated in their researches, and it became difficult to apportion their share in the results, or to give a medal to one without doing injustice to the other. A double medal had been suggested as the remedy, but as the bye-laws appeared to prohibit this, it might be worth while to consider the propriety of altering them in this respect. The President also said that as the number of the satellites of Uranus still seemed doubtful, he would suggest the devotion of some large telescope, and the time and labour of an observer, to clear up the matter. The delay in the completion of Mr. Newall's telescope, which was peculiarly fitted for such work, was much to be regretted, but as the position of the planet was very favourable, though now declining in altitude, he hoped the subject would not be lost sight of.

It was moved by Lord Lindsay, and seconded by Admiral Ommaney, and resolved—

That the Report and President's Address be received, printed, and circulated in the usual manner.

An additional 100 copies were ordered to be printed on account of the interest taken in the Eclipse Expeditions, to supply the observers and others not Fellows of the Society.

W. C. Russell, Esq. and T. Elgar, Esq. were balloted for and duly elected Fellows of the Society.

Major-General Boileau, Captain Parsons, and Mr. Carpenter having been appointed Scrutineers, the ballot for the election of Officers took place. The following were chosen:—

President:

William Lassell, Esq., F.R.S.

Vice-Presidents:

J. C. Adams, Esq., M.A., F.R.S., *Lowndean Professor of Astronomy, Cambridge.*

G. B. Airy, Esq., M.A., F.R.S., *Astronomer-Royal.*
A. Cayley, Esq., M.A., F.R.S., *Sadlerian Professor of Geometry, Cambridge.*
Rev. Robert Main, M.A., F.R.S., *Radcliffe Observer.*

Treasurer:

Samuel Charles Whitbread, Esq., F.R.S.

Secretaries:

Edwin Dunkin, Esq.
William Huggins, Esq., F.R.S., D.C.L., LL.D.

Foreign Secretary:

Lieut.-Col. Alexander Strange, F.R.S.

Council:

John Browning, Esq.
J. Buckingham, Esq.
Thos. W. Burr, Esq.
Warren De La Rue, Esq., D.C.L., F.R.S.
E. B. Denison, Esq.
George Knott, Esq.
J. Norman Lockyer, Esq., F.R.S.
Captain William Noble.
F. C. Penrose, Esq.
Rev. Charles Pritchard, M.A., F.R.S., *Savilian Professor of Astronomy, Oxford.*
R. A. Proctor, Esq., B.A.
Balfour Stewart, Esq., M.A., LL.D., F.R.S.

Upon the motion of Mr. C. V. Walker, seconded by Mr. Birt, the thanks of the meeting were voted to the retiring officers, and the Society adjourned.

We have received Mr. Burt's report of the Lunar Map and Catalogue, up to Dec. 31, 1870.

Solar Eclipse.—Mr. A. Brothers, of the Syracusan Exhibition, was successful in taking no less than five photographs during the totality. The last of his photographs is considered to be of great value and importance.

Mr. Newall's great 25-inch Refractor.—In answer to enquiries, Mr. Newall informs us that the mounting of the great refractor is not yet finished. The chief parts were sent to him nearly a twelvemonth ago. The telescope was erected in March; in August the eye-end arrived, but it is still incomplete, requiring focussing adjustment. Illumination, micrometer, and divided circles are also desiderated. We trust that before long we shall hear of the entire completion of this very important instrument, and thus that no more time than is absolutely necessary will be expended. It will be a great pity that science should longer be deprived of the fruits of this great undertaking, if it can be avoided.

Mr. Grubb and the Great Melbourne Telescope.—Mr. Grubb, in a pamphlet, dated Dublin, March 23, 1870, denies all the charges brought against the great telescope. He examines and answers all the objections in order. "So far as the piers of the instrument are concerned, there has been a double mistake at Melbourne, viz.: first, the allowing of a tracing sent under the caution, that it should not be *used further than for the foundation of the piers*, to get into Mr. Le Sueur's hands without that caution being affixed; and secondly, the mistake of Mr. Le Sueur in using that tracing instead of the true one, with which he was well acquainted here." In this tracing it apapears the clock hole was 3 feet wide by 4 feet high, instead of 2 feet 8 in. by 1 foot 11 in. The defects noticed in speculum A, he affirms to arise from the improper way in which the shellac coating was removed; first, that the shellac had not been entirely removed; secondly, that the surface was sticky in parts; thirdly, that methylated spirits had been used instead of alcohol. He also reprobates the use of water in the cleaning process. "There is," says he, "abundant evidence that speculum A has become unfitted for present use solely *from injudicious treatment at Melbourne.*" He goes into all the other objections which have been made. We would gladly give more detail if we had space.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE LATE SOLAR ECLIPSE.

Sir,—I had forwarded my telescope to Gibraltar, intending to proceed thither from Malaga on the 21st December, but from the delays so incidental to travelling in Spain I was unable to do so, and could only observe the eclipse from the latter city with no other aid than that of a small pocket glass and power of 15.

As the weather, however, was somewhat more favourable at Malaga than at most of the selected stations, a few details of what was seen there may not be without interest by way of comparison with observations made elsewhere, and with better appliances.

In order not only to see what might be possible of the eclipse itself, but also its effects upon terrestrial objects to the greatest advantage, I selected for my station the old Moorish castle, which commands a fine view of the city immediately below it, the beautiful plain with its surrounding mountains, and the bay over which the sun was.

The sky on the forenoon of the 22nd was covered with an upper stratum of thin fleecy clouds, while lower, large heavy masses, moving rapidly, threatened to hide the sun altogether, and after the first contact it was only visible at intervals till about 11.30, when they became nearly stationary, and observing a respectful distance from the great luminary, allowed us to witness the eclipse till the totality. As this drew nigh the great diminution of light was very striking, and just before it the shadow of the moon was seen advancing from the north-west, deepening the gloom in which the distant mountains were already enveloped into darkness.

With the glass the small portion of the disc still uncovered appeared both shorter and wider than I expected, and was more like the segment made by the projection of a large circle upon a smaller, and the final extinction of the light immediately after seemed to me more rapid and sudden than in the eclipse of 1851.

The disappearance was no sooner complete than I perceived on the moon's western limb a beautiful and very delicate semicircle of a pale red tint, and the corona was instantly formed all round. Its general breadth was about one-fourth of the moon's diameter, but some of the rays were obviously longer, and three in particular very much so, one of these being about 20° to the west of the vertex, another 40°, and the third 100° to the east of the same point; and with the glass I perceived in the first and third a small conical-shaped light of a whiter colour, projecting about 2′ from the moon's limb.

To myself and three other observers the colour of the corona was pale red, but a fourth spectator thought it bluish-green; it was, however, decidedly different from the bluish-white tint of that I saw in 1851. Instantly on the sun's disappearance Venus flashed out, and from her proximity to it added very much to the effect. One star likewise was visible through an opening to the N.N.E., but the place of Mercury was covered by clouds, and I could discern nothing of Saturn with my small glass.

Turning to the landscape below, the scene was very grand and solemn, although the obscuration was certainly less than I observed at Helsingborg and Orduna, while the darkened sun with its lurid crown was indeed a "sign in heaven," inducing feelings of awe and reverence.

The sea horizon about 20° both east and west of the sun, but not below it, was of a fine yellow sunset colour. This struck me as singular, for the same phenomenon at Orduna in 1860 appeared on the horizon *opposite* to the sun, on the outer side of the shadow, and although at Helsingborg, in 1851, the greenish and reddish tints were then below the sun, we were very much nearer that side of the shadow; but in the present instance we were looking across three-fourths of it to the south, while no colour whatever was visible to the north, on which side the edge of the shadow was not above 20 miles distant.

I had no opportunity of noticing what effects the eclipse produced upon animals, &c. These were probably, from the state of the weather, less marked than on former occasions; but at the moment of totality a universal exclamation burst forth from the city below us, but whether of surprise and wonder, or of fear, as it was at Orduna, I cannot say.

Of a very good case of meteorological instruments I could make no use, further than to note that the temperature fell from 60° to 55°. The wind also increased in strength to the middle of the eclipse, and fell again after it.

I am, Sir, your obedient servant,

Ealing: Feb. 13, 1871. WM. L. BANKS.

AURORA BOREALIS.

Sir,—The brightest Aurora that I ever saw in this country was observed here on the night of the 12th inst. Its characteristics consisted of broad, comparatively steady, areas of white, and greenish-white light. There were but few moving beams or coruscations. Red light sometimes appeared for brief periods in one or two places. At 9h. 42m. G.M.T., a broad ill-defined arch to the south passed over Sirius and under Regulus, crossing the equator, east of the meridian, at an angle of about 27°, about the same as the magnetic variation here. At this time there was a corona formed above Castor, perpendicular to the arch at the point of intersection. The display now seemed to forsake the northern parts of the sky, while the south, down to an inconsiderable altitude, and the east, and the west, were brightly illuminated. Orion was in a flood of light, and continued so for hours.

In the spectroscope only the strong green line appeared, but this with unusual brilliancy. It was given by the sky all round, and even by the earth. In the reflected light from the ground at my feet it was quite discernible.

The Aurora had but little declined at 2 o'clock, when I gave up observing.

J. BIRMINGHAM.

Millbrook, Tuam: Feb. 15, 1871.

CHANGES ON JUPITER.

Sir,—I beg to send you a few notes made during the months of December 1870 and January 1871, and also a few sketches.

Persistency of Band No. 2.—As Mr. Birmingham truly remarks, this very fine streak has been remarkable for its persistency. Very little change was detected here during the whole of the last apparition, while the changes in the southern hemisphere were exceedingly remarkable. Since the reappearance of the planet, however, well-marked changes have been noticed and confirmed night after night. These may be thus enumerated: first, the appearance of three dark protuberances on the southern edge of the band; second, one or two dark spots have been seen on the northern edge; third, the entire band has been seen very faint, but still broad as usual; fourth, the northern edge has been seen dark and sharp, while the southern edge remained faintly defined; fifth, its width varies slightly in different parts, the average being $2'' \pm$. The distance of this band from the one to the south (No. 3) still remains about $4''$.

Nos. 5 and 6 are, as during the last apparition, very interesting objects, whether we regard the curious forms seen on or near them, or the changes they have undergone and are still undergoing. It was in the bright zone between these streaks that the fine oval of 1869–70 was seen so long. On the south edge of No. 5 a curious square form, as dark, nearly, as the belt, was seen some months ago, and up to December 1870 presented a fairly uniform appearance. During January 1871, however, it was often seen, but was much less sharply defined and more diffuse. It was also followed by two dark protuberances, while occasionally, under good atmospheric conditions, three dark forms were seen.

No. 5 may often be seen nearly as broad and dark as No. 2. To the south of No. 5 may sometimes be seen two narrow bands; and, calling the northern one No. 6, it may be described as a rather dark band, half the width of No. 5, and as far south of No. 5 as that band is south of No. 4. Calling the most southern band No. 7, it may be described as narrower than No. 6, and as far south of No. 6 as that band is south of No. 5. To the south of No. 7 is seen the dusky band-like north boundary of the shade about the southern pole. Such was the appearance of this region at 9 P.M. January 26th, 1871.

The central zone presents less of character than during 1869–70. The festoons are usually, perhaps always, seen when the air is good; but the dark mottled character of the zone is less notable than it was. Occasionally dark streaks are seen in it, and they are parallel to the belts.

As seen in Mr. Crossley's large refractor, the colour of this zone is very slight indeed.

No. 1 has become broader since 1869.

No small bright spots have lately been seen on the disc.

I am, Sir, yours very truly,
JOSEPH GLEDHILL, F.G.S., F.M.S.

Mr. E. Crossley's Observatory,
Park Road, Halifax:
Feb. 3rd, 1871.

ON THE EVANESCENT NATURE OF THE BELTS OF JUPITER.

Sir,—On the evening of Wednesday last, the 8th inst., between 8 and 9 P.M., I was examining Jupiter, in company with a friend, with an 8-in. O. G., when we were rather surprised to see a well-defined dark belt unusually near the north pole of the planet, and after looking at other objects for some time, we again turned the telescope upon Jupiter, and found the same belt still there; but on looking for it again in about 20 minutes, we found to our surprise that the polar belt had entirely disappeared, no trace of it being left. No apparent change had taken place in the other belts, which were very clearly defined, particularly those north and south of the equator.

The above seems a corroboration of a similar thing seen by Sir William Herschel, and I have thought that an account of it may possess some interest.

I am, Sir, your obedient servant,
S. ADAMS.

Yew Tree Road, Edgbaston:
Feb. 13, 1871.

SUPPOSED CHANGES IN CELESTIAL BODIES.

Sir,—I was lately struck with a remarkable instance of how little some of our popular lecturers keep themselves up with the actual state of astronomy, even in regard to facts to which they appeal. I happened to hear a lecture by Dr. Cumming, the other day, in my own neighbourhood, in which he stated that "signs in the Sun and *in the Moon*" had been witnessed lately; and in support of the latter assertion, appealed to changes which had been observed in the lunar crater Linnœus.

By a rather amusing coincidence, I received about the same time a letter from my friend Mr. Birmingham, of Tuam, in which occurs the following passage:—"I had a peep at our old friend Linné the other night, and on the terminator for the second time in my life, and found it a small crater with the edge higher in the west than in the east. I do not believe there has been any change whatever."

I need scarcely remark, that this statement of Mr. Birmingham's is confirmatory of the conclusion which astronomers generally have for some time accepted. I omit all reference to the erroneous view of the nature of the supposed alteration in the appearance of the crater, in imagining that the discovery would have implied any *new* amount of activity on the surface of our satellite, and remain

Yours faithfully,
W. T. LYNN.

Blackheath: Feb. 14, 1871.

PROPOSED OBSERVATIONS OF VENUS.

Observing Astronomical Society.

Sir,—The committee of the above Society have decided to undertake a series of systematic observations of the planet Venus during one complete revolution, for the purpose of obtaining results that shall lead to our becoming better acquainted with the markings which are visible on her surface, and a correct knowledge of their forms and permanency.

In common with all other observers, it has been a matter of regret to them that although this beautiful object approaches nearer to us than any other member of the solar system (our satellite excepted), yet that our knowledge of its superficial condition should be far less than of those planets less favourably situate. In most astronomical works the information concerning Venus is very meagre, whilst the drawings of its appearance exhibit, in the majority of cases, merely a blank crescent.

Yet in turning to the ancient observations made of this planet, the committee have been struck by the large number recorded, many exhibiting well-defined markings, and when they consider the numerous observations of the same character made of late years, including several important ones by members of the Society, it seems evident that the satisfactory examination of this planet is not so difficult as is generally represented. It was seen further, that if a proper discussion and analysis of all recorded observations were made, the result might be a large addition to our knowledge of the planet's surface.

The committee, therefore, in inaugurating this most important movement, divide the work to be done into three branches:—

I. The formation of a sub-committee of astronomical observers (including non-members of the Society) for the purpose of continually observing Venus during one complete synodical revolution.

II. The collection of as many ancient observations and drawings of the planet as possible.

III. The collection of modern data from existing observatories, and from public and private records.

At the conclusion of the observations of the sub-committee, the results obtained, together with the ancient and modern observations collected, will be placed in the hands of a competent astronomer for complete analysis and discussion, when the results obtained will be published.

Those observers who are willing to join the "Venus Observation sub-committee" are requested to communicate their names and addresses to the Hon. Secretary of the Society, before March 10, stating the aperture and power of the instrument they intend to employ.

The observations will commence on March 20, previous to which a circular, containing full instructions, will be issued to every observer who has expressed his willingness to assist in the project.

I am, sir, truly yours,

WILLIAM F. DENNING,

Hon. Sec. Observing Astronomical Society.

Ashley Road, Bristol:
Feb. 15th, 1871.

*** In reference to the above undertaking, the Rev. T. W. Webb says:— "As regards the planet Venus, I enter fully into your idea. That beautiful planet has never received due attention, and the O. A. S. would do excellent service in accumulating materials for a thorough investigation of its surface."

THE SUPPOSED NEW PLANET VULCAN.

Sir,—During the period from March 20 to April 10 it is intended to make another systematic series of observations of the sun, with the object of detecting the suspected intra-Mercurial planet Vulcan in transit, and I shall be glad to hear from any of your readers who may feel desirous of rendering their assistance. If the weather is sufficiently favourable, each person will observe the solar disc during a certain time on every day throughout the above period, and it is to be hoped that by these means the sun will be kept under continual examination.

I am, Sir, truly yours,
WILLIAM F. DENNING,
Hon. Sec. O. A. S.

Bristol: February 15, 1871.

MOCK MOONS.

Sir,—My namesake has been the fortunate spectator of an unusually perfect display of a somewhat rare phenomenon, which however, I suspect, if it were carefully looked for, would be found of more frequent occurrence than may have been supposed. The colour not being so conspicuous as that of the parhelion, it may easily escape notice among clouds of a somewhat similar aspect. There are, however, unquestionably seasons of long duration—possibly of periodical recurrence—during which these appearances, whether connected with sun or moon, are extremely uncommon. I have formerly recorded paraselenæ on several occasions, but not for some years past. They have been referred to, I find, by Pliny, Eutropius, Hevel, and in our own country by the astrologer Lilly; and a fuller search would no doubt bring many more instances to light. A mock moon and several other singular appearances are described in *Nature* 26 January 1871 (the lower wood-cut, by the way, has evidently been inverted by the printer). A season of frequency may possibly now have commenced, and many of your readers may be interested in keeping watch for both solar and lunar appendages of this nature.

T. W. WEBB.

Hardwick Parsonage: Feb. 1871.

Sir,—J. Webb will find an account of mock moons seen in England in Symons's *Meteorological Magazine* for November 1869. I have seen mock moons here on six nights during the last six years, but perhaps they are rarer in the south.

Sunderland: 10th Feb. 1871. T. W. BACKHOUSE.

Sir,—J. Webb will find an account of paraselenæ seen in this country, as well as in others, in Thomson's *Meteorology*, pp. 242–244. On the theory of those appearances (that of parhelia and paraselenæ being similar) information is found in Loomis's *Treatise on Meteorology*, pp. 216–222; also in Kaemtz's *Meteorology*, pp. 426–440 (English translation). A drawing of a remarkable paraselene, seen in 1853 at Stone, is given in *Speculum Hartwellianum*, p. 389.

G. J. W.

CRATER CHAINS NEAR BULLIALDUS.

Sir,—The singular crater chains of Copernicus are well known to most lunar observers, and their striking appearance just after sunrise has been the subject of frequent study; but I should wish to bring into notice the existence of another group of crater chains which, though not so conspicuous as that near the giant Copernicus, is yet deserving of attention.

The region to which I allude lies to the south-west of Bullialdus; here, on the night of July 7th, 1870, using a power of 208 on my 6½" Browning, with reflector, I found the hill γ of B. and M. was very clearly to be identified, and the outline of the broken-down crater ring, of which it forms a portion, could be well traced: but my attention was at once drawn to the region lying between γ and β; here, stretching away from the ring of which γ forms a portion, I saw several crater chains, the individual craters being smaller than those near Copernicus, but yet clearly possessing the same characteristics; one stream of craters at a little distance from γ, was noted as crossing another stream at right angles; the south-west slope of Bullialdus I found to be roughened with innumerable minute hillocks streaming far out into the surrounding plain, with numerous crater rows amongst them.

On referring to Beer and Mädler's map, I found that not a trace of this wonderful region, second only to that of Copernicus, is indicated, and my object in drawing the attention of the readers of the *Astronomical Register* to the subject is to ascertain whether these craters have been formerly observed, as I have been unable as yet to find any notice of them. Could we be sure that B. and M.'s delineation accurately represents the appearance of the district at the epoch of their map, we might then fairly point to this case as indicative of recent eruptive action.

It then becomes of interest to ascertain whether these craters have been before noticed, when they were first seen, or whether any observer is able to supply corroborative evidence that the region has been formerly observed as B. and M. have drawn it.

H. MICHELL WHITLEY.

Penarth, Truro: Feb. 10, 1871.

A BRILLIANT METEOR.

Sir,—Yesterday evening about ten minutes past nine, while walking along a road, I was suddenly startled by a flash of pale-coloured violet light, so intense and vivid, that the trees, hedges, a wall, and the very ruts in the road were distinctly visible for half a mile in front. Thinking it was lightning, I expected that the next moment I should be plunged in darkness, but to my surprise the light continued, and even grew more vivid. It cast my shadow in front; and in wonder, half expecting to see a sun, I turned, and as I turned could see the fields and hedges on my right for nearly a mile, and a wood at the end as plainly as in daylight. Then looking up, I saw a meteor darting towards the west. It disappeared almost the moment I saw it, but the trail remained for nearly two minutes. It was at first nearly straight, but gradually curled up at the ends, grew broader in the middle, and finally seemed to become so diffused in the atmosphere as to disappear. It appeared to be about two degrees to the west of the lower part of Orion. I have seen almost all astronomical and meteorological phenomena, but never observed so intense a light emitted by a meteor. It somewhat resembled the effect produced by the coloured rockets at the Crystal Palace *fêtes.* I fancied I heard a hissing noise whilst the light continued, but this I consider a delusion, having frequently believed I heard crackling sounds during an aurora, which sounds science disbelieves. I put the phenomena down to what I may, perhaps, call homology of the senses, for I notice, if I touch brass and see it, I feel a disagreeable taste in my mouth. Why not, then, upon seeing particular kinds of light, should I not hear, or fancy I hear, sounds?—people sometimes imagine their names are called when no one speaks, as if there were memory of the ear. Now a quick flashing light carries the idea of crackling; the quick passage of a body that of hissing, as a bullet—thus, may not the senses be excited one by the other?

Whilst writing, I would wish to make a remark upon another subject. I see that attention has been recently called to the question as to whether or no the sun's rays, after passing through a vacuum, possess any heating power, it being still alleged that the rays, concentrated by a lens, will not melt ice in a vacuum. That some decrease of heat does accompany vacuum I imagine to be a fact, since at the summit of mountains, where the air is very rarefied, and so approaches to a partial vacuum, the rays of the sun produce scarcely any heat at all. This has been attributed to the absence of radiation, but I question if this completely accounts for the phenomena. If all mountain tops were mere points it might be so, but many mountain ranges are surmounted by table-land of vast extent, yet here the atmosphere is colder than on plains on a level with the sea, though the radiation must be the same. Possibly when atoms of air are wider apart, when air is rarefied in partial vacuum, the heat may pass as it were through, whereas, when the atoms are closer together, they are arrested. If it should be demonstrated that the sun's rays upon passing through a vacuum are shorn of heat, I think an aid will be gained towards the examination of the sun. It has hitherto been found necessary, has it not, upon looking at the sun through a telescope, to employ blackened or coloured glass to protect the eye from the intense heat and glare? Might not a vacuum be substituted for this coloured glass, allowing of a perfectly unobstructed view? If heat only was arrested, and the glare remained, possibly some means might be contrived to diminish the aperture, or shroud the eye, examining a small part of the disc only at one time.

Yours, very respectfully,
RICHARD JEFFERIES.

Coate, Swindon, Wilts.

To the Editor of the *Standard*.

Sir,—Last evening, while walking, at about 9.13 P.M., a light appeared suddenly in the heavens, and, on looking up, I saw a very large and brilliant meteor, in an N.E. direction, which slowly described an arc of a circle terminating in the S.W., leaving in its track a long streak of fire of different colours, which remained stationary for several seconds, and then gradually faded from view. Perhaps some of your numerous scientific readers may furnish you with a better description of this striking phenomenon.

I am, yours, &c.,
JAMES BLAKE.

Dockyard, Portsmouth: Feb. 14.

OBSERVATIONS FOR MARCH 1871.*

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator and of 60° of northern and southern selenographic lat., where the sun's centre rises or sets.

Greenwich midnight		60° N.		0°		60° S.
		SUNRISE:				
		°		°		°
1871. March 1	...	−30·0	...	−32·4	...	−34·8
2	...	42·1	...	44·5	...	46·9
3	...	54·2	...	56·7	...	59·1
4	...	66·4	...	68·8	...	71·3
5	...	−78·5	...	−81·0	...	−83·4
		SUNSET:				
7	...	+72·2	...	+74·7	...	+77·3
8	...	60·1	...	62·6	...	65·1
9	...	47·9	...	50·4	...	53·0
10	...	35·7	...	38·3	...	40·8
11	...	23·6	...	26·1	...	28·7
12	...	+11·4	...	+14·0	...	+16·5
13	...	− 0·8	...	+ 1·8	...	4·4
14	...	−13·0	...	− 10·4	...	− 7·8
15	...	25·2	...	22·6	...	20·0
16	...	−37·4	...	−34·8	...	−32·2
17	...	49·6	...	47·0	...	44·4
18	...	61·8	...	59·2	...	56·6
19	...	−74·1	...	−71·4	...	−68·8
		SUNRISE:				
21	...	+86·8	...	+84·2	...	+81·5
22	...	74·6	...	71·9	...	69·3
23	...	62·4	...	59·7	...	57·1
24	...	50·2	...	47·5	...	44·9
25	...	38·0	...	35·3	...	32·7
26	...	25·8	...	23·1	...	20·5
27	...	+13·6	...	+10·9	...	+ 8·3
28	...	+ 1·4	...	− 1·3	...	− 3·9
29	...	−10·8	...	−13·5	...	−16·1
30	...	−23·0	...	−25·6	...	−28·3
31	...	−35·2	...	−37·8	...	−40·5 (M.)

* We feel sure that our readers will be obliged to our correspondent M. for these valuable communications.

MARS.

Areographic longitude and latitude of apparent centre of disk, angle of position of axis, and diameter.

1871 G. M. T.		Longitude 8h.	10h.	12h.	14h.		Lat. 12h.		Axis 12h.		Diam. 12h.
March 1	...	164°	194°	223°	252°	...	24·0° N.	...	31·7°	...	13·24°
2	...	156	185	214	243	...	24·0	...	31·5	...	13·33
3	...	147	176	205	235	...	24·1	...	31·4	...	13·41
4	...	138	167	197	226	..	24·1	...	31·2	...	13·49
5	...	129	158	188	217	...	24·2	...	31·1	...	13·57
6	...	120	150	179	208	...	24·2	...	30·9	...	13·64
7	...	112	141	170	200	...	24·2	...	30·8	...	13·71
8	...	103	132	162	191	...	24·2	...	30·6	...	13·78
9	...	94	124	153	182	...	24·3	...	30·5	...	13·85
10	...	85	115	144	173	...	24·4	...	30·3	...	13·91
11	...	77	106	135	165	...	24·4	...	30·1	...	13·96

1871 G. M. T.	Longitude 8h.	10h.	12h.	14h.	Lat. 12h.	Axis 12h.	Diam. 12h.
March 12	69°	97°	127°	156°	24·5°	29·9°	14·02°
13	59	89	118	147	24·5	29·8	14·07
14	51	80	109	138	24·6	29·6	14·11
15	42	71	101	130	24·6	29·4	14·15
16	33	63	92	121	24·7	29·2	14·19
17	25	54	83	112	24·7	29·0	14·22
18	16	45	75	104	24·8	28·8	14·24
19	7	37	66	95	24·9	28·6	14·26
20	359	28	57	86	24·9	28·4	14·28
21	350	19	49	78	25·0	28·2	14·29
22	341	11	40	69	25·0	28·0	14·30
23	333	2	31	60	25·1	27·8	14·30
24	324	353	22	52	25·1	27·6	14·30
25	315	344	14	43	25·2	27·4	14·29
26	306	336	5	34	25·2	27·2	14·28
27	298	327	356	26	25·3	27·0	14·27
28	289	318	348	17	25·3	26·8	14·25
29	280	310	339	8	25·4	26·6	14·22
30	272	301	330	359	25·5	26·4	14·19
31	263	292	321	351	25·5 N.	26·2	14·16

March 2: Summer Solstice of Mars' northern hemisphere. Sun's declination or elevation above the plane of the planet's equator = 27° 16′. (M.)

VARIABLE STARS.

Approximate times of minima (or maxima, where max. is mentioned) of variable stars, which according to Professor Schoenfeld (*Astr. Nachr.* No. 1807) and Winnecke (*Vierteljahrsschrift der Astron. Gesellschaft*, v. p. 246) may be expected in March:—

1871	G. M. T.		Place of star 1855. A. R. h.	m.	s.	Decl. °	′
March 2	9h·5	λ Tauri					
—	13·2	δ Librae					
5		R Leonis max.	9	39	45	+ 12	5·9
6	8·5	λ Tauri					
9	12·7	δ Librae					
10	7·5	λ Tauri					
11	14·1	Algol					
—		S Coronae	15	15	29	+ 31	53·5
13	11·5	S Cancri	8	35	39	+ 19	33·2
—		T Piscium max.	0	24	29	+ 13	48·0
14	6·5	λ Tauri					
—	11·0	Algol					
15		R Gemin. max.	6	58	37	+ 22	55·4
—		S Ursae mj. min.	12	37	35	+ 61	53·3
—		T Delphini max.	20	38	38	+ 15	52·5
16	12·3	δ Librae					
17	7·7	Algol					
20		R Leonis min. max.	9	36	52	+ 35	10·6
—		R Virginis max.	12	31	9	+ 7	47·2
21		R Sagittae min.	20	7	27	+ 16	17·4
23	11·8	δ Librae					
27		R Arietis max.	2	7	53	+ 24	22·9
—		T Canis min. max.	7	25	56	+ 12	3·0
28		R Boatis max.	14	30	48	+ 27	22·1
—		S Vulpeculae min.	19	42	27	+ 26	55·7
30	11·4	δ Librae					
31	15·9	Algol					

THE PLANETS FOR MARCH.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	21 36 41	−16 14	5″·4	22 57·5
	15th	23 5 42	8 8½	5″·5	23 31·3
Venus	1st	0 3 15	−0 54	10″·6	1 27·6
	15th	1 6 19	+6 19	10″·9	1 35·5
Mars	1st	12 25 25	+1 15	15″·7	13 47·7
	15th	12 8 24	3 2	16″·8	12 35·7
Jupiter	1st	5 3 42	+22 34	37″·5	6 27·2
	15th	5 8 44	22 42½	36″·0	5 37·2
Saturn	1st	18 34 57	−22 24½	14″·2	19 56·3
	15th	18 38 18	22 21½	14″·6	19 5·1
Uranus	2nd	7 39 12	+22 2½	4″·2	8 58·4
	14th	7 38 13	22 4½	4″·2	8 10·2

Mercury may perhaps be seen in the morning at the beginning of the month, but it is not well situated for observation. It rises about half an hour before the sun at the beginning of the month.

Venus is fairly visible at the beginning of the month, setting about 1.30 after sunset at the beginning of the month, the interval increasing to the end of the month.

Mars is well situated for observation all through the night at the end of the month. He rises before sunset.

Jupiter will still be visible till early morning. It sets at the end of the month at about 4h. 40s.

Saturn can be seen in the morning, rising towards the end of the month four hours before sunrise.

Uranus is very well situated for observation.

New Books.—Mr. Proctor's work on the *Sun*, and Professor Smyth's treatise *On an Equal Surface Projection*, will be noticed in our next Number.

NOTICES TO CORRESPONDENTS.

We are obliged to postpone, for want of space, the Rev. Mr. Ingram's article, "Sun Spots and the Solar Eclipse," and other valuable papers.

Erratum.—At page 27, for Buckingham read Birmingham.

Our readers may have noticed that No. 97 (January) was wrongly paged. We have reprinted the Number, as otherwise the 9th Volume would have been incorrect in this particular.

In deference to an expressed wish, the *Contents* are restored to the position they formerly occupied on the first page of the wrapper.

ASTRONOMICAL OCCURRENCES FOR MARCH 1871.

DATE			Principal Occurrences	Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Wed	1		Sidereal Time at Mean Noon, 22h. 35m. 23·8			Moon — 7 53·3
Thur	2	14 47 6 14 6 57	Conjunction of Moon and Uranus, 0° 46′ S. Occultation of Uranus Reappearance of ditto			8 44·8
Fri	3		Saturn's Ring: Major Axis = 35″·93 Minor Axis = 15″·46	3rd Tr. I. " Tr. E. " Sh. I. 2nd Oc. D. 3rd Sh. E.	6 1 8 44 11 18 12 14 14 5	9 37·0
Sat	4		Meridian Passage of the Sun, 11m. 58s. after Mean Noon	1st Oc. D.	12 33	10 29·2
Sun	5	15 57	Conjunction of Mercury and ι Aquarii, 0° 1′ N.	2nd Tr. I. " Sh. I. " Tr. E. 1st Tr. I. " Sh. I. 2nd Sh. E. 1st Tr. E. " Sh. E.	6 46 9 20 9 26 9 49 11 8 12 3 12 4 13 24	11 20·9
Mon	6	15 39	○ Full Moon	1st Oc. D. " Ec. R.	7 2 10 34 41	12 11·7
Tues	7	20 7	Conjunotion of Moon and Mars, 1° 27′ S.	1st Tr. E. 2nd Ec. R. 1st Sh. E.	6 33 6 45 38 7 52	Jupiter — 6 5·5
Wed	8					6 1·9
Thur	9					5 58·4
Fri	10			3rd Tr. I. " Tr. E.	10 0 12 45	5 54·8
Sat	11					5 51·3
Sun	12			2nd Tr. I. 1st Tr. I. 2nd Sh. I. " Tr. E. 1st Sh. I.	9 24 11 44 11 58 12 4 13 3	5 47·7
Mon	13	10 19	☾ Moon's Last Quarter	1st Oc. D. " Ec. R.	8 58 12 30 31	5 44·2
Tues	14	13 43 17 25 18 24	Conjunction of Moon and Saturn, 0° 59′ N. Occultation of B.A.C. 6161 (6) Reappearance of ditto	1st Sh. I. 3rd Ec. R. 1st Tr. E. 2nd Ec. R. 1st Sh. E.	7 32 8 2 9 8 29 9 21 9 9 48	5 40·7
Wed	15		Illuminated portion of disk of Venus = 0·921 of Mars = 0·999	1st Ec. R.	6 59 24	5 37·2

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Thur	16		Sidereal Time at Mean Noon, 23h. 34m. 32·1			Mars 12 30·4
Fri	17					12 25·0
Sat	18		Meridian passage of the Sun, 8m. 16s. after Mean Noon			12 19·7
Sun	19	15 50 21 41	Opposition of Mars Conjunction of Moon and Mercury, 3° 7′ N.	2nd Tr. I.	12 4	12 14·3
Mon	20	16 0	● New Moon	1st Oc. D.	10 55	12 8·9
Tues	21			1st Tr. I. 3rd Ec. D. 1st Sh. I. " Tr. E. " Sh. E. 2nd Ec. R. 3rd Ec. R.	8 9 9 23 30 9 27 10 25 11 43 11 56 40 12 3 57	12 3·5
Wed	22	16 25	Conjunction of Moon and Venus, 4° 40′ N.	1st Ec. R.	8 55 14	11 58·1
Thur	23		Saturn's Ring: Major Axis = 37″·06 Minor Axis = 15″·82	2nd Sh. E.	6 40	11 52·7
Fri	24					11 47·3
Sat	25					11 41·9
Sun	26	9 17 10 23	Occultation of B.A.C. 1272 (6) Reappearance of ditto			Moon — 4 8·7
Mon	27	5 6 23 55	Conjunction of Moon and Jupiter, 1° 10′ N. Superior Conjunction of Mercury	1st. Oc. D.	12 52	4 55·8
Tues	28	18 44	☽ Moon's First Quarter	3rd Oc. D. 2nd Oc. D. 1st Tr. I. 3rd Oc. R. 1st Sh. I.	8 15 9 24 10 7 11 3 11 22	5 44·5
Wed	29	22 53	Conjunction of Moon and Uranus, 0° 59′ S.	1st Oc. D. " Ec. R.	7 22 10 51	6 34·7
Thur	30			2nd Sh. I. " Tr. E. 1st Tr. E. " Sh. E. 2nd Sh. E.	6 34 6 49 6 52 8 7 9 18	7 25·8
Fri	31					8 17·2

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MARCH 1871.

By W. R. Birt, F.R.A.S.

Day	Supplement ☾ − ☉ Midnight	Objects to be observed
	° ′	
1	62 1	Copernicus,* crater chains between it and Eratosthenes.
2	50 42	Anaxagoras, its streak system.
3	39 4	Aristarchus,† Eratosthenes, aspect of interior.
4	27 5	Gassendi, its remarkable interior.
5	14 42	Hevel, Lohrmann, Cavalerius.
6	1 58	Cordilleras, D'Alembert Mountains.
23	147 34	Promontorium Agarum, Condorcet.
24	136 31	Taruntius, Messier, Biot.
25	125 36	Mare Nectaris, ridges on the western part.
26‡	114 47	Mare Serenitatis, ridges on the western part.
27	103 58	Mare Serenitatis, small craters near the Terminator, west of Linné.
28	93 5	Mare Frigoris, Timæus, Bond,§ Barrow.
29	82 2	Thebit. Straight Wall, Alpetragius.
30	70 43	Teneriffe Mountains,¶ Archimedes.
31	59 4	Bullialdus, Agatharchides,‖ Gassendi.

By adding the period of similar phase, 59d. 1h. 28m., to the epochs of observation of the appearances of objects in January, the time in March will be given at which the same objects may be seen under nearly the same conditions of illumination. The position of the terminator as given, for example, in the February Number, if continued, should be registered with each observation.

* Nasmyth's spiry shadow, see *De La Rue's Diary* 1868, may be looked for. I can find nothing like it: see *English Mechanic*, No. 291, p. 28.

† Browning's *second* peak in Aristarchus, see *Student*, April 1869, p. 192, may be looked for. Consult also *English Mechanic*, No. 296, p. 219.

‡ Winter solstice in N. hemisphere, N. pole in darkness.

§ A group of fine formations exists in this part of the moon, ill figured and badly described by Selenographers. The fine lozenge-shaped formation between Timæus and Barrow it is proposed to name Bond, in commemoration of the discoverer of the obscure ring of Saturn.

¶ A group of mountains S. of Plato on the Mare Imbrium, named to commemorate an astronomer's experiment: see *Monthly Notices R.A.S.*, vol. xxiv. p. 20.

‖ Adjoining Agatharchides is a ring nearly filled. It is not in Webb's Index Map, but is an interesting object for observation.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.

Field, H.
Huggins, Dr.
Kershaw, A. E.
Webb, Rev. Rev. T. W.

To January 1871.

Porward, R.

To March 1871.

Brothers, A.
Cotsworth, H. E.
Elliott, R.

To April 1871.

Lewis, H. K.

To June 1871.

Banks, W. L.
Gooch, Miss.
Slater, Jas.

To August 1871.

Locke, W.

To September 1871.

Pratt, H.

To December 1871.

Backhouse, T. W.
Baldelli, Mdme.
Barber, J. T.
Cundell, G.
Glover, Rev. J. H.
Hill, C.
Johnson, R. C.
Perigal, H.
Ryland, J. G.
Vernon, G. V.
Walker, G. J.
Whitbread, S. C.

To June 1873.

Banks, R.

February 20, 1871. Subscriptions after this date in our next.

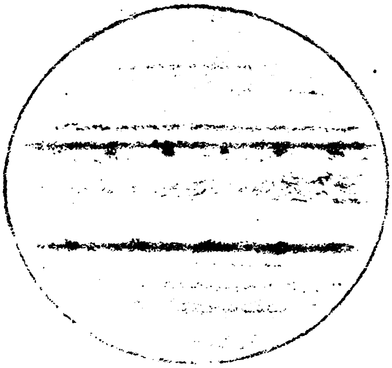
The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham, House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

OBSERVED AT M^{R} E. CROSSLEY'S OBSERVATORY, *PARK ROAD, HALIFAX.*

JUPITER

1



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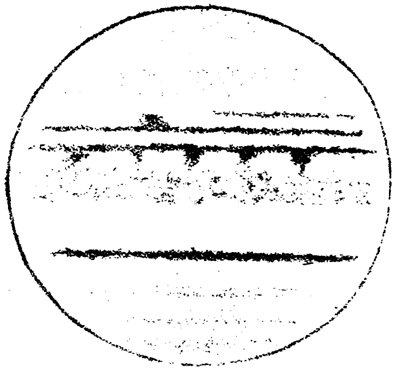
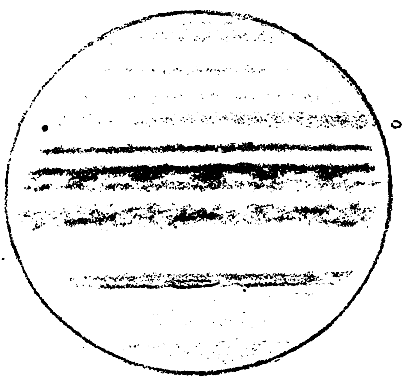
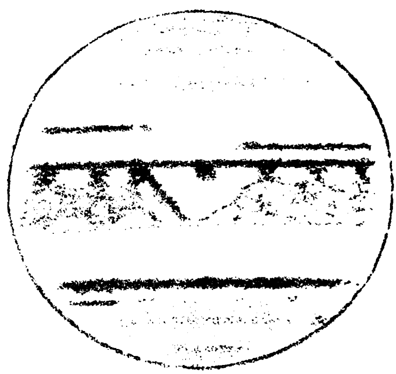


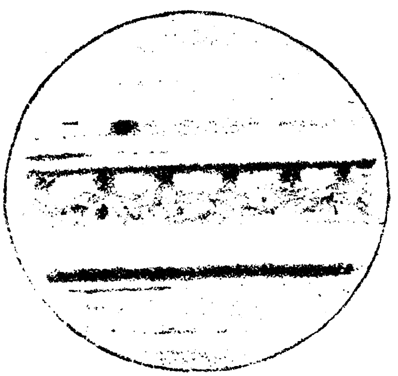
3



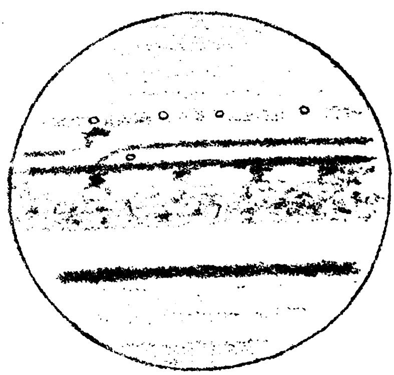
4



5



6



1	Sep^{t}	24^{th}	1870.	$12^{h}\ 30^{m}$	G.M.T.
2	"	"	"	14^{h}	" " "
3	"	26^{th}	"	$13^{h}\ 15^{m}$	" " "
4	"	20^{th}	"	15^{h}	" " "
5	Oct	10^{th}	"	$12^{h}\ 30^{m}$	" " "

The Astronomical Register.

No. 100. APRIL. 1871.

OBSERVATIONS OF JUPITER.

By Joseph Gledhill, F.G.S., F.M.S.

At Mr. Crossley's Observatory, Park Road, Halifax.

Partly owing to bad weather and partly to the fact that, soon after a heavenly body has passed the meridian, houses and chimneys render good vision impossible, this planet has not been so carefully watched of late. The evening of March 4th was fine, and some observations were made on the present appearance of the disk. The minuter forms were, however, not well seen.

At 6h. 37m, P.M. No. 1 was well seen: near the west limb this band was darkest and broadest. No. 2 was dark and broad along its western half, while that of the east was fainter. No. 3 was either broader or much better seen than is usually the case.

The western half of No. 5 was fairly seen, its breadth being equal to that of No. 4. About the centre of that part of the disk this band seemed to fall down to No. 4. The eastern portion was not distinct. Five dark patches were seen under and in contact with No. 4 and having bright spaces between them: now and then these came out as festoons or ovals.

To the south of No. 5 was seen a broad dusky band about 3 times the width of No. 5. This is the position occupied by No. 6. It was not, however, seen clearly cut off from the shaded region of the pole by a brighter portion, as is often the case.

Its western and central portions were darker than the rest,

The amount of shading about the southern pole was strikingly greater than that about the opposite pole,

The broad central zone was carefully examined, and has been seldom better seen. It was not only less coloured and fainter, but also more distinctly dappled (the cloud-like patches being larger) than it has been hitherto noticed. The dusky region about the S. pole was but a little less deeply shaded than this central zone.

At 7h. 45m. the western half only of No. 1 was seen, while the eastern half of No. 5 was fully in view. This latter band at its western extremity (now central) sloped down to No. 4, as did the eastern end of the portion seen an hour before.

P.S.—If Mr. Adams really observed a well-defined streak to the N. of band No. 1 (see *Register* for April 1870), the observation was well worth recording, independently of the rapid disappearance of the object: For neither during this apparition nor the last has any band or marking been detected nearer the N. pole than No. 1 at this observatory.

The Equatorial and Polar Regions.—Repeated observations seem to show that the depth of shade in these regions varies in different parts. Sometimes the shading about the S. pole is much deeper than that about the N. (Feb. 25th, 1871, at 7 P.M.) Sometimes the difference is scarcely perceptible (March 13th, 1871, 8 P.M.) The central zone has been seen but little darker than the southern polar region, as on the 4th of this month at 7 P.M., while at 8 P.M. on the 13th both poles were bright in comparison with the deep tone of the zone bounded by 3 and 4.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Fifth Meeting, March 10, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last ordinary meeting (January) were read and confirmed.

Sixty-four presents were announced, including a copy of the second edition of Professor Roscoe's most valuable work on *Spectrum Analysis*. The thanks of the meeting were voted to the respective donors.

William Mann, Esq., Royal Observatory, Cape Town; E. W. Snell, Esq.; and F. W. Levander, Esq., were balloted for, and duly elected Fellows of the Society.

Mr. Talmage complained that the latter part of his paper on the Eclipse, in which he recorded his thanks to some officers of Engineers who rendered him most valuable assistance, had been cut out in its printing in the *Monthly Notices*, and was informed by the Secretaries that the editor had full power in this respect over the printing of papers, and was referred to Professor Cayley for his reasons.

The following papers were announced and partly read:—

On a Mode of Protecting Observers when using Reflectors of large size in the Open Air: by Mr. Browning.

The author exhibited a model of his contrivance, and explained it orally. He said it was admitted that while large reflectors performed best when uncovered, this was certainly not the case with the observer, who was then exposed to the serious effects of wind and cold. He had therefore planned the model shown, and intended to have it carried out on the full size necessary. The model consisted of three pillars, arranged on a triangular platform, movable on castors, between which a small room, suspended by pullies, and counterpoised, was made to ascend and descend by the change of weights in the room. This contained a desk for recording observations, and was well ventilated. The door could be fastened, to prevent the observer falling out, and to the upper open half a frame was fixed, by which a hood could be attached to the eyepiece of the telescope, thus keeping the wind off the observer, and placing his eye in complete darkness, as recommended by Mr. Proctor. Mr. Browning suffered much from exposure to the sun by day, as well as from cold, and he believed the white sides and ventilators would protect him from this inconvenience when observing solar phenomena.

Occultation of η Cancri: by Capt. Noble.

The times were given.

Note on the Occultation of Uranus: by Capt. Noble.

This was predicted for 14h. 7m. S.T. on February 3. The author adjusted his telescope on the planet, and at 14h. 5m. S.T. returned to witness the occultation, but found Uranus had already disappeared. Such an error in the *Nautical Almanack* is rare, except in the case of Jupiter's satellites, where the predictions are sometimes many minutes wrong.

Mr. Dunkin: The tables in use give an error of $15''$ in the place of Uranus, and as the moon moves $2{\cdot}5''$ in a minute, this would produce an error of 4 or 5 minutes in the time of the occultation.

Note on the Misuse of a common Symbol: by Capt. Noble.

The author protests against the use of the symbol ″, which properly means seconds of arc, for any other purpose. In the *Monthly Notices*, he has recently seen "$24''$ E. of Greenwich," and that Dr. Robinson observed the eclipse with a telescope of "$7''$ aperture," meaning in one place seconds of time, and in the other inches.

The Astronomer-Royal: I always make a point of distinguishing seconds of time from seconds of arc; and as to inches, I write the word in full.

Mr. Penrose: It is now quite the fashion for engineers and others engaged in mechanical operations to use ′ for feet and ″ for inches.

The Astronomer-Royal: Perhaps there is some excuse in the original etymology of the words, which were:—*minuta prima* and *minuta secunda*; we have preserved *minuta* for the larger divisions and *secunda* for the smaller. Carpenters and such-like workmen are the only persons who use ″ for inches. It is convenient for them, who have nothing to do with astronomers or observations.

The President: I have been much struck by what the Astronomer-Royal has said, but the analogy is not carried out; ' *minuta* are not used for smaller divisions, but for feet, which are larger.

Mr. Penrose: It is quite hopeless to attempt to get carpenters and workmen out of this practice.

The Astronomer-Royal: I tried to get the marks altered, but without success. The Germans appear to be the greatest offenders in confounding seconds of time and arc, and using $''$ for both, and inches as well.

Observations of the Solar Eclipse of December 1870, *made at the Royal Observatory, Greenwich*: by the Astronomer-Royal.

As this eclipse offered a favourable opportunity for detecting the errors of Hansen's Lunar Tables, the author arranged four sets of observations with the great equatorial and altazimuth. The measures included the N.P.D. of the cusps, the differences of the time (R.A.) of the limbs of the sun and moon, and the differences of N.P.D. of the north limb of each of those bodies. Some of the early observations were lost through clouds, but the remainder formed the data for five equations. The results obtained show that the tabular excess of the moon's R.A. over the sun's R.A. requires to be diminished by $6{\cdot}47''$, and the excess of the moon's N.P.D. over the sun's to be increased by $1{\cdot}21''$, while the semidiameter of the sun given by Leverrier's Tables requires a correction of $-1{\cdot}68''$, and that of the moon from Hansen's Tables $-0{\cdot}49''$. From meridian observations made on days preceding and following the eclipse, the tabular errors of the sun were found to be $+0{\cdot}11^s$ in R.A. and $+2{\cdot}2''$ in N.P.D. The altazimuth observations of the moon during the eclipse showed the tabular errors in azimuth to be $-11{\cdot}0''$ for the second limb, and $-3{\cdot}83''$ for the first limb, the error of semidiameter being $+3{\cdot}5''$. Combining these results, it appears that both instruments give precisely the same values for the tabular errors of the R.A. of the moon $+0{\cdot}54^s$, and for N.P.D. $+1{\cdot}0''$ and $+2{\cdot}5''$ respectively. The coincidence in the error in R.A. may be accidental, but it is eminently satisfactory. From the altazimuth observations, the sum of irradiations of sun and moon amounts to $4{\cdot}0''$, while from those of the great equatorial, which has a much larger object-glass, the value appears to be only $0{\cdot}5''$.

The Astronomer-Royal: It may be desirable to add a few observations to this general *précis* of results, respecting the nature of the operations. I took no part in the observations myself, having found that it is now better to lay out the scheme with great care, and trust to younger eyes and younger energies to carry it out. In carefully considering what can be done with a large partial eclipse, I have found that observing the ingress and egress gave only two data, and those very inaccurately; while, from the plan of observation here adopted, four things can be determined. In deciding on this scheme, I had the apparent places of the sun and moon computed for every five minutes, from which a diagram was made, showing the circumstances of the eclipse at short intervals during its progress. I studied this diagram for an evening or two, and determined on my plan, which I afterwards submitted to Professor Adams. At the beginning of the eclipse, the moon is advancing on the sun, and forms cusps. Now, if the tabular place of the moon relatively to that of the sun is too far advanced, the differences of N.P.D. of the cusps will be increased, and at the end of the eclipse they will be diminished. From these observations, we shall detect any important error of the tables in R.A. Again, at the beginning of the eclipse, if the tabular diameter is rather too large, the cusps will be lengthened, and the same effect will take place at the end. Thus an error in R.A. produces opposite effects at the end and at the beginning of the eclipse, but an error in the diameter produces an effect of the same kind at both times. The N.P.D. of the cusps must, therefore, be constantly measured. Other things are the differences of the semidiameters of the sun and moon, which will be found from the differences of the north limbs of the sun and moon near the centre of the eclipse; at other times we get the differences affected by errors of R.A. These observations are combined in various ways, and enable us to say in such a part we see various classes of errors. The observations are exceedingly delicate, and require great care. I decided to divide them into seven different parts, in each of which differences of N. P. D. only, without R.A. differences, gave equations for the satisfactory discussion of errors. One thing peculiar to Greenwich should be mentioned, and that is the mounting of the great equatorial, which enables us to measure differences of N.P.D. which could not be done with an instrument of the German form. I believe the equatorials of Greenwich and Cambridge are alone capable of this work. The moon passed nearly horizontally over the sun at this eclipse, and N.P.D. differences were therefore only used. At other times, R.A. differences were measured. The reduction of the measures presented extraordinary difficulties, and required much labour. It is one thing to say, Here are the tabular places of the sun and moon, where are the cusps? and to draw them on paper. This is easy, but to work out the results by figures is extremely hard. Another thing is, that having found out by the tables where the limbs of the sun and moon intersect, the result is complicated by the errors of R.A. and N.P.D., and in the semidiameters of both bodies, so that it becomes no joke to work it all out in algebra.

However, this has been done, and the result is worthy of the highest confidence. Four things have been attained—the correction of the R.A. and N.P.D. and the semidiameters of the sun and moon, and far better than can be got in any other way. One of the American astronomers went to Gibraltar not to observe the physical phenomena of the sun, but determined, when the shadow should pass, to trace by it the exact place of the moon. I told him I should do better at home. How it would have eventuated (as the Americans call it), I can't say. He had bad weather, and the telegraphs which he required to get his longitudes were interrupted, but we certainly obtained a good result by our complicated and laborious process. I have used this plan several times before, and even began it at Cambridge. It shows the necessity of having firm equatorials.

Erratum in the Results of the Observations of the Solar Eclipse, 1860: by the Astronomer-Royal.

On the Zodiacal Light: by Mr. Ranyard.

On the 19th December, while engaged on the Eclipse Expedition in Sicily, the author witnessed a brilliant display of the zodiacal light. The form was conical, but blunted at the apex. It was white, like the Milky Way. He tested it for polarisation with a Savart band prism, and at first thought he saw lines. He then called Mr. Burton, who saw some bands, with the centre black. Turning to the sky, even at 180° distance, it was free from these appearances. The next night was again fine, and Father Secchi thought he saw a faint band. These observations, if confirmed, show that the light is not only matter, but consists of small particles, comparable with the wave lengths of light or matter capable of specular reflection.

Mr. Brothers remarked that Venus would interfere very much with similar observations just now.

The President said he never saw the zodiacal light so fine as at Malta, but it was of a different colour to the Milky Way, being redder.

Captain Noble referred to a paper of his, in which he stated it was brighter than the Milky Way. That paper had a different object, viz., to show that the zodiacal light did not lie in the plane of the ecliptic, as popular books on astronomy taught. His observations were on spring evenings.

The Astronomer-Royal inquired whether anyone had seen it on autumn mornings?

Mr. Penrose said he did last year, when travelling in Spain, when it was very brilliant.

Note on the Corona: by Mr. Proctor.

Mr. Proctor stated that this paper called attention to the important result shown by the agreement between photographs taken by Mr. Brothers in Sicily and the American observers in Spain as to the configuration of the outer or radiating part of the corona corresponding with the inner and brighter part, which confirmed the explanation of the corona as a solar appendage.

Note on the Distribution of 326,000 *Stars in Argelander*: by Mr. Proctor.

In the discussion upon Mr. Proctor's papers on the Distribution of Stars, he had been advised by Professor Pritchard to test his views by their application to Argelander's Zones. He therefore now proposes to map the number above mentioned on four large sheets, and have these reduced by photography. This would bring the stars so close as to run into one another, and produce a sort of graining, which would indicate the direction of their tendency to mass together, and, the author believes, give some important results.

On the Colour of the Moon during the late Eclipse: by Mr. Proctor.

The green colour of the moon described by some observers in Spain might at first seem to be connected with the green line in the spectrum of the corona, but the colour of the corona was not at all green, and this will not account for the observed tint. If, however, we consider the appearance of the face of the earth which would be turned towards the moon, it would probably be mostly green or blue, and the earth, as seen from the moon, being fourteen times as large as the moon is to us, we shall understand that a considerable amount of greenish light might be received by the moon and reflected back to the earth. The spectrum of this light would be continuous, but was doubtless too faint to be recognised. In 1860 the colour of the moon is described as reddish; and as a different part of the earth, having much more land, was then turned to the moon, this is equally explained. The curious result follows that the earth as seen from Venus may be variable in colour, and that the changes may be used to determine the rotation periods.

Mr. Ranyard: There is another way of accounting for the green colour. If the light be polarised and reflected back twice between the moon and earth, one end of the spectrum may be cut off at one body, and the other end at the other, and thus the middle of the spectrum remain. Professor Stokes has accounted in this way for a strong green colour seen between two banks of clouds.

The Astronomer-Royal remarked that all statements of colour should be received with great diffidence, on account of the effect of contrast in producing illusion as to colours.

Captain Noble instanced the well-known experiment of looking at an object of one colour, and finding its complementary tint produced on looking elsewhere.

Mr. Hudson stated that the moon looked green in the telescope, but black to the eye alone; and that he thought his eye was not very sensitive, and therefore unlikely to be much affected by contrast. During the voyage home, when Professor Tyndall was experimenting on the colour of the water in the screw-well, he (Mr. Hudson) had some difficulty in detecting the various colours.

The Astronomer-Royal asked Mr. Dunkin whether, during the eclipse of 1851, he did not see the water at Christiana yellow.

Mr. Dunkin said that the sea was there full of islands covered with green trees, all of which looked yellow, but the water between looked deep purple.

Mr. Brothers then exhibited a series of photographs taken by him at Syracuse, during the eclipse, and some other illustrations of the results of the expedition, by means of a lime-light lantern kindly supplied by Professor W. G. Adams, of King's College; and some stereoscopic photographs of the eclipse, showing that, by combining the second and fifth pictures taken during totality, the moon stood out away from the corona. The two first pictures were views of the telescope and observatory; then came one of the partial eclipse, taken at Manchester with a very small picture, showing the effect of cloud in lighting the moon, and one of the prominences as seen before the eclipse. Five photographs of the totality were next shown, two of them exhibiting the corona in great beauty; and the last illustration was a combination of the photographs of Mr. Brothers and Mr. Willard (taken in Spain), and a drawing by Professor Watson, made at Carlentini, all agreeing exactly as to the position of the rifts in the corona, and thus proving that it was situated near the sun, and not affected by distance or atmospheric causes. Letters from Sir John Herschel and Dr. Balfour Stewart were read to the meeting by Mr. Brothers, assenting to this view. The time of exposure of the plates varied from 8 to 15 seconds. The apparatus used consisted of a camera with a lens of 30-inches focus, made by Dallmeyer, mounted on an equatorial telescope.

Dr. Huggins said that, it being doubted whether the rifts were shown as identical in the photographs taken by the Sicilian and Spanish parties, he made an appointment with Professor Winlock to examine them, and found, upon the most careful comparison, that the two principal gaps were certainly identical, and two others nearly so.

Mr. Ranyard: In Lord Lindsay's pictures, the effect is marred by the wires across the plate looking like crowbars, which obscure the parts where some of the rifts would be well seen.

Mr. Hudson: Paper pictures from the American photograph and that of Mr. Brothers being mounted on a card, if placed correctly, show the correspondence of the rifts distinctly. As to my sketch, if compared with Lieutenant Brown's, it shows a great similarity, although my business being polarisation, I could not devote much attention to drawing.

Abstract of the Report of the Agosta Eclipse Expedition: by Professor W. G. Adams (King's College). In consequence of the lateness of the hour, Professor Adams merely stated that his paper mentioned he was himself unable to do much with the polarisation apparatus, but that Mr. Clifford, through the cloud, saw some traces. Mr. Burton confirmed the existence of the American green line in the spectrum of the corona, and Mr. Brett made some coloured drawings.

Mr. Brett, the eminent painter, then exhibited the three beautifully-finished drawings made by him, with the aid of a silvered-glass reflecting telescope of 8½-inches aperture, and a small achromatic refractor. The first showed the thin line of light just before totality, with a very curious brush issuing from each cusp. In the second, the thin line was seen breaking up into Baily's beads; and the third, taken during totality, exhibited the red flames and sierra of prominences in an exquisite manner.

Mr. Brothers enquired whether the limb of the moon seemed to the eye to be surrounded by the red light of the prominences.

Mr. Brett: The drawing shows all I saw. The prominences were heaped up in patches of red, yellow, and white.

The Solar Eclipse: by Rev. S. J. Perry.

The meeting, which was very crowded, then adjourned.

RED LINE IN AURORAL SPECTRUM.—On your p. 55, in the report of the Royal Astronomical Society, it is stated that the red line in the auroral spectrum was observed first on April 5, 1870. This is a mistake, it is mentioned in my letter which is printed in your number for August 1869, p. 185. T. W. B.

FUTURE ECLIPSES.—I fear, unless some one of our contributors has the requisite tables and leisure, the questions of "Astronomicus" will remain unanswered for some time. I have not tables of the moon's epochs extending so far as the dates in question. G. J. W.

W. J. McD.—The monthly notices of the Royal Astronomical Society are included in the bound volumes of the Memoirs of the Society, and are sold to the public (at prices according to the size or contents of the volume) by Williams and Norgate, Henrietta Street, Covent Garden.

SOUTHERN LATITUDES.—We shall be very glad to receive occasional notes from our correspondent at Sydney, and have no doubt they will prove interesting to our readers. No new edition of Admiral Smyth's *Cycle* has yet appeared.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

SUPPOSED CHANGES IN THE MOON.

Sir,—My excellent friends Messrs. Birmingham and Lynn having appeared on the arena of controversy as regards the vexed question of "Linné," will you allow me in the briefest space possible to offer two or three remarks on the subject?

First: The acquaintance of English selenographers with "Linné" dates, so far as I am aware, from 1866, October 16. Between the early part of February 1867 and the present time, or rather 1871 January 27, the date of the last observation which has reached me, "Linné" has been seen as a craterlet, not exceeding a mile in diameter, and during the interval no indications of a physical change have occurred. 1871, February 26, 6·10, I observed "Linné" with 2·75 inches aperture as a slight depression very similar to the object in the Mare Crisium which I noticed after the cloudy patch west of Picard had *disappeared,* and which I believe is recorded in your pages. The usual cloud-like appearance characteristic of "Linné" at a later illumination was absent. Of course I failed to see the craterlet with this aperture.

Second: I have been waiting for the last four years for some *evidence* of the inaccuracy of Lohrmann's, Beer, and Mädler's and Schmidt's drawings and descriptions of "Linné," but have hitherto failed to obtain any. There may possibly be among your readers gentlemen who may be able to supply this desideratum founded upon data *otherwise* than the different aspect which the crater now presents to that which it must have presented if those drawings and descriptions are correct.

Third: It is exceedingly important in an enquiry of this kind to hold "opinions" very loosely. The perception of truth may be long retarded if *they* be held tightly and defended with energy. On the other hand, the patient collection of "facts" tends greatly to establish the truth. It is the *fact* of the inaccuracy of former selenographers which we need to determine the question.

Yours truly,
W. R. BIRT.

Walthamstow: March 3, 1871.

PERFORMANCE OF A ZENITH SECTOR.

Sir,—I have just read in the December number the report of Col. Strange's paper "On the performance of a Zenith Sector, &c.," read at the meeting of the R.A.S. held Nov. 11, and feel called upon to rectify some extraordinary mistakes, and explain some very unmeaning extracts therein contained. It is unnecessary to speculate what shares are due respectively to Col. Strange, to your reporter, or to your printer in the confusion, resulting in great measure, apparently, from the shortness of the verbal extracts from my letter to Col. Strange. I refer to a copy of that letter to aid me in rectifying.

1. I have no idea what is meant by my having measured a base line

between March 20 and April 4. I never measured a base line in my life (though I have aided in doing so in previous years); and if I had, what has it to do with the matter in hand? The extract which follows is not so accurate as, I do not doubt, it is in Col. Strange's paper.

2. The expression "five minutes as a limit for closing a star list" should be "for choosing a star list."

3. The accuracy of the graduation is inadequately represented by saying merely that "no error exceeds 2″"; that might well be taken to mean that no *space* is 2″ in error. But this was not at all what I intended when I wrote, "I question whether the error of position of any division exceeds $\pm$ 2″ as compared with the mean of all." As I believe that the magnitude of each division is nearer × 10″ than 4″, this amounts to saying that were a mathematically true series of radii, 5′ apart, applied as a test, every such radius would fall nearer to the middle than to either side of its respective graduation.

4. The next sentence, "No instrumental error is more than 1″ after 6 or 7 hours' work," is unsupported by anything I have written, except the following, which I give *in extenso*, as it explains the condensed statement, to which I object as both vague and misleading: "My observation-record is made to show the zero-error of microscopes at every observation (generally before passing on), so that mistakes may be detected on the spot. This is a joint test of graduation, intersection, and observation errors, as well as of stability; and it is satisfactory to find that the extreme range is not greater than $\pm$ 1″ for 6 or 7 hours' work." The "stability" referred to here is not that of the axis of rotation (except during the minute between the two star intersections), but of the microscope arms and other parts subject to change of zero; not, however, including the levels. I should add that I reject, unhesitatingly, any observation which gives a zero-error, unexplained by irregularity of circle readings, differing by 1¼″ from the mean, because I am satisfied that 1″ is the extreme limit to be expected. The rejections of this kind do not amount to more than three or four in 1,000.

5. The sentence which immediately follows contains an exaggeration. I wrote that "in about *three cases out of four*" all the members of a triplet fall within a range of 1″.

6. We come next to accuracy of result. Generally speaking, it is not fair to exclude individuals of a group, when precision is under consideration, without cause shown. In this case, out of the 50 stars observed, only 22 were immediately available; and of these, two were rejected for reasons then only surmised, but since proved sufficient—the erroneous place of Procyon in the N.A. for 1870, and the non-identity of individuals in the case of γ Virginis.

7. The next sentence is best read by the help of the original. It is only necessary to say that, as my experience as an astronomical observer was *nil*, I referred merely to my practical acquaintance with *angular measure* of a high order, viz. that with the best modern surveying instruments. The following extract, the last which I need make, also explains the strange sentence further on about "the error" being "reduced to 0″·2." "I would not be over confident, but the *order of accuracy* indicated by these flying reductions has no parallel in my experience. I take no credit on the score of observation; I attribute it wholly to the instrument, and believe it can do still better. As regards latitude only, I am satisfied that one night's observations (of 36 stars in six hours) will suffice to give a result whose probable error will be *not greater than one-fifth of a second*."

I think, Sir, that I am entitled to ask for the insertion of this letter, on the score of justice; for, dear as is the reputation for accuracy to us all, it is so in an especial degree to those whose vocation is scientific; to none more so than to myself; and in this particular instance I am misrepresented as making unqualified statements which, where they are not of doubtful meaning, are of doubtful correctness.

I am, Sir, yours truly,
J. HERSCHEL, Capt. R.E.

P.S.—The accuracy of a Zenith Distance observation, or (as in Talcott's method) of that of the difference of two Zenith Distances, depends directly on the "level correction." However perfect other things may be, or however ingenious the method, imperfection of levels mars all. *Levels are now inferior to graduation.* Until that is rectified, Talcott's method is at too great a disadvantage. That is a sound practical objection, in addition to others of a more special character, depending on the objects and purposes in view. I take occasion to say so here, because the time has come to urge on manufacturers that the inaccuracy of level curvatures is becoming an insuperable obstacle, which they alone can remove.

J. H.

Cape Comorin Base: Jan. 15, 1871.

SOLAR SPOTS.

In the *Astronomical Register*, No. 92, Aug. 1870, p. 184, is an article entitled "Solar Spots." Permit me to suggest the following as a more satisfactory method of delineating the spots, when it can be applied to a telescope which is accurately driven by clock-work, viz.: a square of glass is kept in position behind the eye-piece by means of a frame held by a bracket or support sufficiently strong to prevent vibration, and resist moderate pressure of the hand: this to be clamped upon the eye-piece end of the telescope. Upon one surface of the glass a piece of *thin* tracing paper is pasted, and when dry is ready for use, as a screen, by being fixed in the frame by a "button," and the image of the sun focussed upon it. It will be found that upon the tracing paper thus fixed, the position and much of the detail of the spots can be traced with a fine pencil. It is scarcely necessary to add that several plates of glass (accurately cut to a gauge, so as to be easily introduced into the frame) should be in readiness; each prepared with its tracing paper, for any number of powers used in carrying out the detail of the spots. When the drawings are finished, each plate with its paper is to be introduced, for a few minutes, into a vessel of water, after which the paper may be easily removed from the glass and mounted as best desired, upon stout white paper.

Yours, &c.,

North Shields: Feb. 4, 1871. W. B. CLARKE, M.D.

P.S. In laying down the line of meridian or parallel upon the drawing, I would suggest the following arrangement, viz.: that fine wire parallels should be stretched across the surface of the frame nearest to the eye-piece, the meridian line corresponding with the axis of the telescope; between these wires and the eye, the plates of glass, with their tracing paper, are to be adjusted. Previous to the position of the spots being noted, the sun's limb, E. W. N. & S., must be made to correspond with the shadow of the respective wires, and the meridian and other parallels carefully drawn, with rule and pencil, over the shadows respectively, *under a low power.*

Upon using the higher powers to display the detail of the larger spots, &c., I would suggest that, after the general view of the solar disc, the meridian and other parallels have been drawn, and the disposition of spots pencilled in, under a *low power*, the necessary adjustments, horizontally and vertically, must be made by the telescope, so as to bring each spot or group of spots, into the centre of the tracing paper, after each power is adapted, and the focus adjusted.

The progress of the spots each day (or at each determined period) will be shown by marking them carefully with the point of the pencil; drawing the meridian and other parallels, under a sufficiently *low power*. Dots made at the four cardinal points of the sun's disc will enable the circle to be completed by a disc of card laid between them, and drawing the circle round the circumference.

REVIEWS.

The Sun: Ruler, Fire, Light, and Life of the Planetary System. By R. A. PROCTOR, B.A., F.R.A.S. (London: Longmans).

A complete work on the sun would almost of necessity be a complete history of astronomy, for no branch of the subject can be treated without reference to the mighty globe which occupies the centre of that system in space of which our world is a part. That which can be done without extending the work to impracticable dimensions has been done, and we need scarcely say done well, by Mr. Proctor, in the welcome addition to astronomical literature which now lies before us. It is a very different matter to write a work upon the sun in the present day, to what it would have been only (let us say) five-and-twenty years ago. Discovery has followed discovery of fresh methods of observation; photography, the polariscope, and the spectroscope, in the hands of observers of unrivalled ability, have opened fields of research which but a short time ago were totally unexplored. It will be readily imagined, therefore, that a large portion of Mr. Proctor's work is devoted to modern discoveries on the solar surface; in fact, our author candidly states that he does not attempt to give an account of the steps by which our knowledge of the sun's central position in the solar system has been obtained. The question of the sun's distance, however, so lately re-determined by the most accurate methods obtainable by modern observers, is thoroughly gone into; and the importance due to the approaching transits of Venus, whereby we may hope to confirm the recent measures of the solar parallax, is properly appreciated. The great part played by the spectroscope in giving us indications of the structure of the solar surface is dwelt upon, the methods of observation explained, and the instruments described; the physical condition of the sun is considered, and the researches of astronomers in the great question of the system of suns, of which our luminary forms a part, is dealt with, as far as modern astronomical enquiry enables the subject to be treated.

A profusion of explanatory woodcuts and many excellent coloured lithographs adorn the work, and we feel sure that this latest contribution by Mr. Proctor to the astronomer's library will be received with satisfaction not only by those especially interested in solar research, but by the scientific public generally.

On an Equal Surface Projection for Maps of the World. By Professor C. PIAZZI SMYTH, F.R.SS. L. & E.

This interesting paper was in its first and shorter form read before the Royal Society of Arts in Scotland on May 9, 1870, but has been subsequently enlarged and published. Its object is to produce maps "representing the whole world at one view, and in the most equal possible manner." This could never be with the old Mercator's maps, where there is always a great distortion of the apparent sizes of the polar over the equatorial portions of the world, to a degree beyond the power of mere eye and judgment to correct at every step. The mode of getting over the difficulties is best described in the Professor's own words:—"The disadvantages may be instantly eliminated by simply representing the latitudes as *sines* upon an otherwise Mercator's projection, and adopting at the same time the arc length of 90° for the radius or straight meridional distance from the equator to the pole, and then we have not only the very poles themselves definitely included on the paper, but the areas of parts between different latitude parallels and longitude meridians, made of the same proportions as on a true sphere; while the distortion which is inherent in every representation of any sphere's surface on a plane is nearly confined to a flattening of the extreme solar regions, for at 50° 13′ of latitude the proportions of the latitude and longitude degrees are true, and below that, though there is an extension in latitude, it is comparatively slight." Such a map once projected may be used for a variety of purposes. The Professor applies it to the temperature of the earth's surface—to barometric pressure—to the world's land and sea surface, but the chief and most novel application is to the deciding upon the earth's centre. Hitherto each particular country has looked upon their own land as of central importance. The ancient Greeks spoke of Delphi as μεσόμφαλος; the navel stone, as it were, of the whole earth. Modern savans of London speak of it as the centre of all the land surface of the world, but then they include the unhabitable polar regions, and exclude South America and Australia. Some say Liverpool, and so on. But by reference to his map and the tables deduced from a study of it, having regard to climate and other points connected with the existence of man upon the face of the earth, he comes to the conclusion that there is a definite longitudinal meridian which might, with great propriety, be fixed upon as a starting-point for all nations, and that thus the inconvenience of Frenchmen reckoning from Paris, the English from Greenwich, the Portuguese from Ferro, others from Washington, Berlin, Altona, Pultowa, and Vienna, might be corrected by choice of one place, and this he thinks not only possible but reasonable, and free from objection and even likely of acceptation. "By referring to Tables III. and IV., it will be perceived that they make the land surface toward the north to be exactly equal in extent to the land surface towards the south on either side of a certain latitude parallel, not the parallel of London (where the proportions N and S are 13 to 59), nor of Delphi (where the proportions are 24 to 48), but of the far more southern latitude 25° 30′ N. (where the proportions are 36·12 to 36·12 as was seen Line AA on Plate IV.) While the world's same total land surface towards the west is equal to that towards the east on either side of the longitude meridian of either 29° 5′ E. or 150° 55′ W. (see lines BB and bb on Plate IV.) giving two crossing points with the latitude parallel for the land centre of the earth's surface—between these two we can have no difficulty in choosing, for 150° 55′ W. traverses little or nothing but sea from pole to pole, while 29° 5′ passes over far more land than sea. There are other separate results pointing to a meridian between 25° and 35° East as having the honour of making or including the longitude meridian of the only unexceptionably measured centre of all the *inhabited and inhabitable* land surface of our globe." The conclusion is that the great pyramid of Egypt, a building of itself admirably fitted for a longitude monument, should mark a first meridian for all the world. The maps which explain these theories are very well executed and particularly clear.

The Rev. J. H. Broome's ingenious pamphlet upon the astral origin of the Hebrew Alphabet has been reprinted from the *Register*, and may be had in a separate form of Mr. Macintosh, 24 Paternoster Row.

NOTES ON THE WONDERS AND BEAUTIES OF THE STARRY HEAVENS.

By C. Grover, Assistant to John Browning, Esq., F.R.A.S.

No. 3. The Constellation Lyra.

This compact and elegant little asterism, though of much less extent than the constellations of Ursæ Minor and Cassiopeia, which have previously engaged our attention, contains several objects of so much beauty and interest as to richly reward the attentive observer who may devote any portion of his time to their examination; in fact, bearing in mind the limited area occupied by its outline on the celestial vault, this constellation is exceedingly rich in telescopic work. Its position in the heavens is such, that it transits the meridian at convenient hours for observation, during the summer and autumn months. The R.A. of Vega, the lucida of the asterism being 18h. 33m., it follows that on the first days of August, September, and October, it culminates at 9h. 45m., 7h. 49m., and 6h. 2m. respectively; and its distance north of the equator, amounting to 38° 40′, is such as to place it just within the circle of perpetual apparition for our latitude, so that under favourable atmospheric conditions, and in situations free from obstructions, it may be seen at its lower transit, just above the Northern horizon; at the upper transit its altitude of about 76° makes it a rather inconvenient object for the achromatic telescope, but, as we have previously pointed out, this causes no inconvenience to the Newtonian reflector.

The student may feel interested in comparing the light of this first-class star with a few of the other gems of our northern hemisphere, as Sirius, Arcturus, Capella, and Procyon, especially when we bear in mind the fact that such estimations, conducted by the most able observers, are far from being so accordant as could be wished; and it must be admitted that the science of Photometry, or light-measuring, is in a somewhat unsatisfactory condition; not altogether from a want of proper instrumental appliances, or from any lack of skill in the observers, but in a great measure owing to the actual impediments which bar the path of the student who wishes to arrive at accurate conclusions as to the relative brightness of the stars.

Of the four stars just named, the first is by far the brightest ornament of our hemisphere, and Vega, though of inferior lustre, ranks next in order of brilliancy; but we think few of our readers will agree with Wollaston, who allowed it but $\frac{1}{9}$ of its brightness, for, as the Rev. T. W. Webb very justly remarks, nine Vegas compacted into one would surely outvie any star in the firmament. Procyon ranks next in order, followed by Arcturus and Capella; the difference in brilliancy of these last two stars being so minute, that I have often found a difficulty in deciding which was entitled to the pre-eminence. These differences are easily seen, but an exact determination of their relative luminosity could not be made so readily; for this purpose it is obvious that the objects under examination should not greatly differ in altitude, should be situated in equally dark portions of the heavens, the atmospheric conditions must be very favourable, and the moon quite absent, added to which the optical capacity of the instrument employed must have been well determined by previous observations of some objects of well-known magnitudes; and lastly, any peculiarities of vision to which the observer may be liable must be duly considered and allowed for. The fulfilment of all these conditions is a matter of extreme difficulty; but the student who diligently labours in this department of astronomy will find his reward in the discovery of more diversity of brilliancy among the stellar host, and even among stars recorded by our best authorities as of similar magnitudes, than is generally supposed. In saying this we do not overlook the fact that many such discrepancies may be due to actual changes, of which we have many well-known examples; but there still remains a considerable number of disagreements, which may be fairly attributed to the difficulties just mentioned. A large telescope with low power shows this fine star, with many lesser companions, including two faint pairs; one, N.P., the other, S.F., and it is inserted in the catalogues of most double-star observers, on account of an 11th magnitude companion, distant 43″, on a position angle of 135°, another somewhat brighter star lying nearly at right angles to this, and at about three times the distance. These were the nearest known companions of the great star till Mr. Buckingham announced at a meeting of the R.A.S. in 1867 the discovery, with his 20-inch achromatic, of three other most minute points, much closer to the primary than those just mentioned. He has been able to verify their existence with a 9⅓-inch object-glass; and one is stated to have been seen with only a 5⅓-inch achromatic. I am not able to add anything from my own observations as to these delicate objects, though I have repeatedly searched for them with the 12¼ speculum, and powers up to 500. On several occasions I have noticed minute points of light which might have been taken by a casual gazer for the objects sought, but I could never satisfy myself of their reality; and to prevent the least tendency to any bias on the subject, I carefully avoided any reference to the published positions and distances, and they are purposely omitted here in the hope that some reader possessed of adequate optical means may be induced to undertake an independent search for these interesting objects.

Referring to the difficulties incidental to measuring, the late Rev. W. R. Dawes, speaking of the 11th magnitude companion, remarks: "The small star bears more illumination than might have been supposed from its minuteness;" and the statement that Sir John Herschel's 18¼-inch speculum showed it immediately after sunset, and with a moon, has been instanced as a proof of the light-grasping power of the metallic disc. As much has been done with the 12¼ silver or glass speculum, in which I have several times seen it within a few minutes of sunset; and on the 23rd of September 1870, it was beautifully distinct in Mr. Brindley's 8½-inch equatorial reflector, within less than half-an-hour after sunset, and in such broad twilight that the smallest figures of the *Nautical Almanack*, and the graduated circles of the equatorial, could be read without the least difficulty. The beautiful blue tint of this little star is particularly distinct on such occasions, and affords a striking proof of the superiority of the silver film over the metal mirror so far as illuminating power is concerned.

The Monthly Notices of Papers and Proceedings of the Royal Society of Tasmania for March, April, and June 1870 contain several valuable articles, including contributions to the phytography of Tasmania, by Dr. Ferd. von Müller, and some additional observations on the more recent changes which have taken place in the star η Argus and its surrounding nebula (with diagrams) by Mr. F. Abbott.—*Nature.*

SOLAR SPOTS OBSERVED DURING THE ECLIPSE

BY THE REV: T. INGRAM, STEYNING, SUSSEX.

FIG. 1.

(Inverted image)

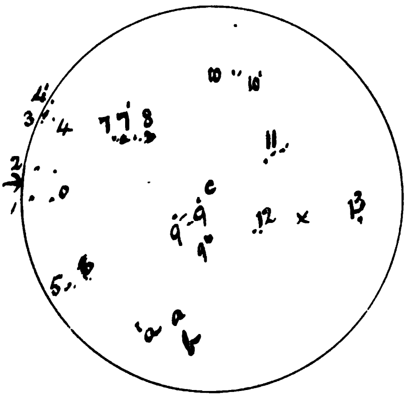
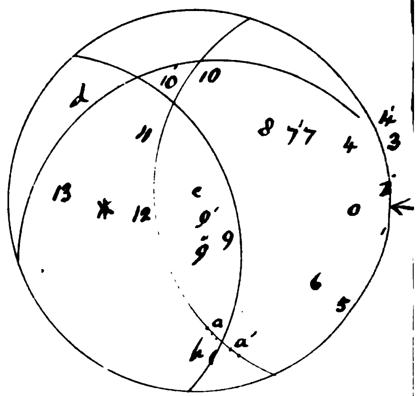


FIG. 2.

(Non-inverted spectrum)



STANDARD NUMERALS DESIGNED BY COL. A. STRANGE, F.R.S.

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NUMERALS DESIGNED BY R. S. NEWALL, ESQ.

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NOTES OF SOLAR ECLIPSE AT STEYNING, SUSSEX, DECEMBER 22, 1870.

Observed time of commencement 11h. 7m. 40s.* at the point marked with arrow in diagram (1). Wind E.N.E., nearly calm, but with occasional gusts of force 6 (one such gust directly after commencement of eclipse).

Obscuration of spots as numbered in diagram (1) (first contact unless otherwise stated).

Spot	No.	Observed time h.	m.	s.	Watch probably about 40s too slow, G. M. T.	
	0.	Not seen until after mid-eclipse				
	1.	11	9	40.		
	2.	11	9	50	(?) *not exactly* (Wind almost calm).	
Group of spots near Sun's W. Limb.	3.	11	10	20	(immersion).	
		11	11	10	(total disappearance).	
	4.	11	13	33	(therm. (4 ft. from ground) in shade 26°.	
	4'.	11	12	35.		
	5. 6.	times not observed (very small spots).				
Large Group of spots.	7.	11	31	18	1st contact with penumbra.	
		—	31	35	" " umbra.	
	7'.	—	32	38	" " penumbra	Wind freshening E.N.E.
		—	33	17	" " umbra	
		—	34	0	total disappearance "	
Largest of large group.	8.	11	38	4	1st contact with penumbra	Thin cirrus clouds crossing.
		—	39	2	1st contact with umbra	Good definition obtained here. Time exact.
		—	40	28	total disappearance of umbra	
		—	—	—	total of penumbra not observed (clouds crossing in fresh E.N.E. current).	
Small central group	9.	11	37	29	1st contact, or immersion.	
		—	39	2	total disappearance.	
	9'.	11	42	19	immersion.	
		—	—	—	total disappearance not observed.	
	9''.				not observed till after mid-eclipse.	
	10.	11	52	19	immersion.	
		—	—	—	total disappearance not observed.	
	10'.	—	53	15	immersion.	
		—	—	—	total disappearance not observed.	
Group of 4 small spots.	11. 1.	12	6	18	immersion	Sensible diminution of light (with yellow tinge) at 12h. 13m.; giving a penumbra of about ½-inch to one's shadow on a white door.
	2.	—	7	55		
	3.	—	—	—	not observed	
	4.	—	12	12		
	12. 1.	—	1	4	immersion	
	2.	—	—	—	not observed	
	13.	—	20	35	immersion.	
		—	—	—	total disappearance not observed.	

* Calculated time of commencement 11h. 6m. 58s.

† Misplacement of No. 12 in diagrams.

N.B.—The Moon's position is *approximately* given in diagrams at 11h. 50m., 12h. 23m. 40s. (mid-eclipse), and 12h. 49m. (the latter position being taken without data to fix it).

Steyning, Sussex,

	°	′	″		
Lat.	50	53	20	N.	9½ miles N.W. by W. from Brighton (see Mr. Hind's
Long.	0	19	30	W.	letter in *Times*, 19th December).

Notes on diagrams (1) (2). The position of the groups of spots is only given with approximate accuracy. Group 11 is, I think, too near *c*, the sun's centre. The arc *d* gives a larger mid-eclipse than was seen. The spots as given can easily be identified on a photograph of sun.

Apparent bluntedness of horns of Sun during the Eclipse.

Observed time

h.	m.	s.		
11	27	30	lower horn	Good definition was often impossible from the wavy appearance of lines, owing to the radiation of heated moist air from the ground.
11	29	20	upper horn	
11	48	29	lower horn	
12	11	40	upper horn	

Observations of the limb of the Moon.

h.	m.	s.	
11	50	0	Mountains observed on eastern limb, as roughly marked at a, a, in diagram (1), like grains of sand on a smooth edge. (Good definition obtained.)
12	49		Valley in western limb, as roughly marked at b in diagram (1).

Miscellaneous Notes.—Position of observer, *a warm nook, sheltered from N.W. and N.E.* Rotundity of moon very observable by the play of yellow light on the parts nearest the sun, shading off to darkness at centre. No Bailey's beads observed. No planets seen, though carefully looked for. Wind E.N.E. throughout. Clouds more frequent in S.S.E. quarter at about 12h. 43m. to 12h. 53m. Detached cirrus, lower sides murky, of a purplish copper hue, at 12·53 (reflecting the darkened landscape), upper sides often of a pinkish copper tint, specially on an apparent arc about 12° above the sun, at 12h. 53m. A few flakes of snow at 12h. 58m.

* Thermometer readings in sun

Time—	h.	m.	s.	°
	12	13	0	33
	12	15	0	32
	12	20	0	31
	12	35	0	29
* A spirit minimum thermometer	12	43	0	28
	12	53	0	30
	12	57	0	32
	1	43	0	42

Telescope by Dollond, 2-inch aperture, power 50 lineal.

Barometer not read. It was steady at (29·79-in.) Cocks crowing very much at 12h. 13m. Birds fighting for roosting places as at evening. Starlings changing direction of flight as if baffled. Pigeons taking short low flights round.

All observations after mid-eclipse were interrupted. No times of reappearances noted.

Colonel Strange's Standard Figures for Astronomical Instruments.—We give with this number a drawing copied from a photograph sent us by Colonel Strange of the standard figures designed by him for engraving on the circles, &c. of astronomical instruments. Many subscribers have expressed a wish that we should give this illustration; it is not, however, intended as a *standard* illustration of the figures, but is perhaps as near an approach to the original as our means enable us to give. Colonel Strange writes us to say that he has as yet met with no one able to copy the figures satisfactorily by hand, and that he intends having them engraved on copper or steel by the machine constructed for the purpose, and will lend us the plate, so as to enable us to give our subscribers a correct copy of the figures. We have also given a set of figures as designed by Mr. Newall, of Gateshead, for the same purpose.

HACKNEY SCIENTIFIC ASSOCIATION.

At the fortnightly meeting of this Society, held on Jan. 24th, there was a large attendance of members and friends to hear a lecture by Mr. W. R. Birt, F.R.A.S., Vice-President of the Hackney Scientific Association, on "Evidences of recent Lunar Changes." The lecture was illustrated by many beautiful drawings, including some new and remarkable diagrams, projecting the curves of visibility of the spots on Plato.

Mr. Birt said that he proposed to examine the statement that "the surface of the moon had taken up its final condition myriads of ages ago." Having glanced at the well-known agencies, illumination, reflexion, visual ray, and the varying states of the earth's atmosphere, capable of effecting apparent changes in the appearance of objects, of a temporary character, he proceeded to state that, being desirous of testing the remote antiquity of the moon's surface, he had, with the assistance of several gentlemen, collected during 20 lunations as many as 1,600 observations of the 37 spots now known on the floor of the walled plain of Plato. These had in the first place been subjected to a discussion relative to their visibility, the result being that the curves of 24 spots had been projected; these curves, however, were not in accordance, a few pairs only were similar, but these pairs of similar curves appeared to indicate the operation of agencies very unlike those producing apparent change. Out of the 37 spots the curves of 9 only agreed in presenting maxima in August and September 1869. By these maxima is to be understood the fact that those particular spots were much more frequently seen in August and September 1869 than at any other times during the 20 lunations. Even the visibilities of these nine spots varied very irregularly amongst themselves, and were not similarly affected, as all the spots on an area of 60 miles in diameter ought to have been, had such agencies as illumination, &c., only affected them. Another important fact, which the lecturer pointed out, was that these spots, with two exceptions, were found on the western part of the floor of Plato. In February and March 1870, another group of eight different spots, differently situated, manifested increase of visibility. These spots were found on a band situate on the southern part of the floor, and their curves were much less in accordance than those of the first group. Another group of eight spots (but not the same) on the southern part of the floor, and extending from the E. to the W. border of Plato, manifested increased visibility in August and September 1870. These facts, the lecturer said, were irreconcilable with the principle that *all* the changes observed were only apparent, and pointed out, on a series of well-executed diagrams, the great dissimilarity which existed between the curves of certain spots, in support of his views. While, however, he laid great stress upon this dissimilarity, he called attention to the *pairs of similar curves* to which he had before alluded. The spots furnishing these curves were, he said, situated near the borders of the plain, and it was just here that the floor had been observed to dip towards the base of the mountainous wall, as if a fissure existed there, and he quoted Scrope and Hopkins to the effect, that the expansion of rock by heat would elevate the superincumbent covering, and that when the force of tension became greater than that of cohesion, the surface would be ruptured, a system of fissures formed, and a subsidence of the disturbed tract effected. These phenomena had very probably occurred on Plato, and the similarity of the curves of the spots near the border would seem to indicate the continued operation of the agency which had produced the dip of the floor and the probably existing fissure. After alluding to the celebrated case of the crater Linné, as an example of change, the lecturer remarked, that to the opinion which seemed to be gaining ground amongst astronomers—that no change had occurred in the crater—he must demur emphatically, saying, "Not on evidence." So far as he had been able to learn, not a particle of evidence had ever been adduced to prove that Lohrmann, Beer and Mädler, and Schmidt had been in error; indeed, the whole of the evidence which had come under his notice tended to establish change. We needed, however, further observation, and although evidence of change is difficult to collect, it is not unlikely that the quiet grey plains of the moon may be found to exhibit (distance for distance) as much activity as exists at present on the earth.

At the close of this impressive lecture, listened to with the utmost interest and attention, numerous questions were put and answered, and a cordial vote of thanks was passed to the eminent lecturer.

LITERARY AND SCIENTIFIC INSTITUTE, BEDFORD.—On Thursday evening, February 2, a lecture was delivered in connection with this Society, at the Working Men's Institute, by Mr. T. G. E. Elger, on "The Physical Constitution of the Sun." As a rule, scientific lectures do not seem to present much attraction to popular audiences; but on this occasion Mr. Elger undoubtedly succeeded in throwing around his subject a charm and freshness which are generally foreign to dry philosophical details and elaborate calculations. To render his explanations more clear he had a very fine series of diagrams, prepared by himself, representing the various solar appearances,—sun spots, protuberances, spectra, &c., all of which contributed largely to the effect of the information collected in his valuable lecture. Tracing the study of the solar disc from the earliest period of observation down to the latest researches of modern science, he detailed the labours of the leading professors from the days of Galileo to the present time, explaining the several theories and entering into exhaustive analytical investigations based on the data already supplied by means of the spectroscope and other modern scientific instruments. A description of the results of various observations taken during total eclipses of the sun formed a most interesting and valuable feature in the lecture. The various phenomena observed by himself in Bedford were accurately represented on the diagrams, and his hearers were struck with the able manner in which he collected within a short space all the available facts connected with the influences exercised on magnetic currents by the solar changes. The lecture was throughout of a superior character, showing in the minutest details the deep acquaintance of the learned gentleman with his subject. A cordial vote of thanks was unanimously accorded to Mr. Elger at the close.

NEW PLANET.—A new minor planet was discovered by M. Luther at Bilk on March 12, 1871. It will be No. 113. G. F. C.

The war has stopped all continental sources of news.

ON THE DETERMINATION OF THE LOSS OF INTENSITY OF LIGHT DUE TO MOLECULAR WORK DONE IN TRAVERSING A GIVEN DISTANCE OF THE LUMINIFEROUS MEDIUM.

By Lieut. A. M. DAVIES, R.A.

The equation of energy being

$$m\left(\frac{dx}{dt}\cdot\frac{d^2x}{dt^2} + \frac{dy}{dt}\cdot\frac{d^2y}{dt^2} + \frac{dz}{dt}\cdot\frac{d^2z}{dt^2}\right) = \mathcal{X}\frac{dx}{dt} + \mathcal{Y}\frac{dy}{dt} + \mathcal{Z}\frac{dz}{dt},$$

its first integral will be, if v be the velocity of the particle m,

$$\tfrac{1}{2}\,mv^2 = \int(x.dx + y.dy + z.dz)$$

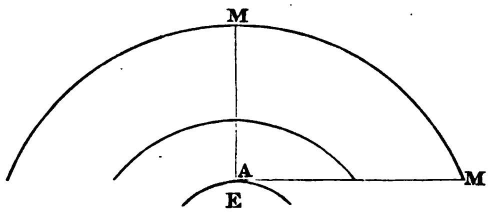
$$= \text{work done by the forces.}$$

in what follows we will premise the following. *Absorption* is the loss of actual energy in doing absolute work.

Now let I be the intensity of sunlight at greatest meridian altitude,

I_1 the same on horizon.

Then $I - I_1$ is the loss by absorption, and according to our enunciation is the loss due to the work done by the Sun's rays in traversing the additional depth of the earth's atmosphere, -



in other words, the work done in instituting molecular disturbance in a column of air whose depth is

$$(AM_1 - AM) = f \text{ feet suppose.}$$

The mean density being the same in both and $= \delta$

Let ω be the velocity of an atom of the interstellar medium vibrating light.

Ω be the velocity of an atom of air (nitrogen and oxygen) vibrating light.

m the mass of an atom of the medium, M the mass of an atom of the air. Then

$\int m\,\omega^2 =$ the vis viva of a cylinder of the medium reaching from the limits of the atmosphere to the sun.

$\int M\Omega^2 =$ the vis viva of a cylinder of equal section of the atmosphere whose height is the extreme height of the atmosphere under the sun's greatest meridian altitude.

$a\int M\Omega^2 =$ the vis viva of a similar cylinder measured on the horizon.

a being the ratio of AM_1 to AM. Now assuming the work done directly proportional to the loss of intensity, we have

$$(a-1)\int M\Omega^2 = I - I_1$$

Observation gives

$$I = 1300\ I_1$$

$$(a - 1)\int M\Omega^2 = 1299\ I_1$$

now $(I - I_1)$ is known. Therefore

$$(a - 1)\int M\Omega^2 \text{ is known.}$$

Again $$\int m\omega^2 + \int M\Omega^2 = \frac{aI}{I_1}\int M\Omega^2 + \frac{I}{I_1}\int m\omega^2$$

$$(I_1 - I)\int m\omega^2 = (a\,I - I_1)\int M\Omega^2$$

$$\int m\omega^2 = \frac{a\,I - I_1}{I_1 - I}\int M\Omega^2$$

Now let the length of medium traversed be p times the length of air traversed, and let for equal lengths

$$e\,.\frac{m\omega_1^2}{2} = \frac{M\Omega_1^2}{2}$$

$$\frac{m\omega_1^2}{2} = \frac{M\Omega_1^2}{2e}$$

Where e is an assumed quantity we have to find—

$$m\omega_1^2 = \frac{M\Omega_1^2}{e}$$

$$\int m\omega^2 = \frac{a\left(\frac{I}{I_1}\right) - 1}{1 - \left(\frac{I}{I_1}\right)}\int M\Omega^2$$

$$= \frac{a\left(\frac{I}{I_1}\right) - 1}{1 - \left(\frac{I}{I_1}\right)}\int \frac{p}{e}\,.\,m\omega^2$$

$$\therefore\ e = \frac{p\left(a\,.\left(\frac{I}{I_1}\right) - 1\right)}{1 - \left(\frac{I}{I_1}\right)}$$

Now the loss of intensity due to a known length of air is given by the equation

$$(a - 1)\int M\Omega^2 = I - I_1$$

and the loss of intensity through an equal length of medium is $\frac{1}{e}$ times this quantity.

The value of e has already been found in terms of known quantities, and therefore the loss of intensity due to the passage of sunlight through a particular length of the luminiferous medium is given by the equation

$$\frac{m\omega^2}{2} = \frac{M\Omega^2}{2e}$$

The late CHARLES FRODSHAM, born April 15th, 1810, was the third son of the late Mr. W. J. Frodsham, the eminent chronometer maker, who, while he devoted himself to the higher branches of his own art, took an active part in the promotion of general science, and attained the honour of admission as a fellow of the Royal Society. Mr. Charles Frodsham was brought up to his father's business, and showed in his early manhood a remarkable faculty for undertaking the more minute and intricate calculations involved in the construction and regulation of chronometers. In 1847, Mr. Frodsham was presented with the Telford Medal, for a paper on the Isochronism of the Balance Spring, which forms the second part of this volume, and was also complimented on the same occasion by being made an Associate of the Institution of Civil Engineers. In 1862, Mr. Frodsham was appointed a Juror in Class XV. in the London International Exhibition, and published a very clever and exhaustive report on "Chronometers, Watches, and Clocks." He was also in the same year the author of another treatise, entitled, "A Few Facts connected with the Elements of Clock and Watchmaking." Mr. Frodsham served twice as Master of the Clockmakers' Company. He was also appointed a Juror of the Dublin Exhibition 1865, and both as Juror and Vice-President of the Paris Exhibition in 1867. Although excluded by his position as Juror from all competition on those occasions, he gained eleven medals, among which was the grand gold medal of the Emperor of Russia. Mr. Frodsham was several times a member of the Council of the Royal Astronomical Society. He is justly entitled to take his place in the age in which he lived, as one of the most distinguished English watch, clock, and chronometer makers.

DEATH OF PROFESSOR DE MORGAN.—We are sorry to announce the death of Mr. De Morgan, which occurred on Saturday, March 18, at Camden Town. This great mathematician was son of an officer in the British army; he was born at Madura in 1806. He went to Trinity College, Cambridge, and in 1827 was 4th Wrangler; religious objections prevented his taking the degree of M.A. On leaving the University he entered Lincoln's Inn, and in 1828 was elected Professor of Mathematics in the London University. This post he resigned in 1831, but was re-elected in 1836, and held the appointment till 1866. The Professor was for 30 years a member of the Council of the Royal Astronomical Society, and for 18 years one of the Secretaries. The amount of work he got through during his useful life is simply amazing. He was the great advocate of a decimal coinage. He continued his active life almost to the end. There are few men of our day who have deserved so well of the scientific world.

THE EARTHQUAKE IN THE NORTH OF ENGLAND.—Another slight shock of earthquake has been felt in the north of England, taking a S.W. and N.E. direction. Though in some cases small articles of furniture were moved, bells rung and beds shaken to the alarm of the occupants, who fancied, in certain cases, that there was some one under the bed moving it, the shaking does not appear to have been so violent as others during this century. The effects are said to have been most severe at Ulverston and Lancaster. There seems to be no doubt that the British Isles are connected with the real earthquake regions to the south, and that a distinct movement took place on Friday 17, in that subterranean channel.

MR. HUGGINS'S OBSERVATORY at Tulse Hill has been rebuilt, and in place of the former dome of 12 feet diameter, a drum of 18 feet has been erected for the great equatorial (refractor of 15 inches, and reflector of 18 inches), by Grubb & Sons of Dublin, which has been placed in Mr. Huggins's hands by the Royal Society. At present, observations for the adjustments of the instrument only have been made.

We hear from *Nature* that one of the Temple Memorials will be an Observatory for Rugby. The telescope to be erected is Mr. Dawes' $8\frac{1}{4}$ inch by Alvan Clarke, $108\frac{3}{4}$ focal length: it is mounted equatorially, and has an excellent driving-clock; the eye-pieces range from 90 to 1,000. Other instruments for astronomy, surveying, and meteorology will be added. There is some fear lest the Masters' disputes may for a time prevent these good things from being accomplished, but we trust that the delay will not be long.

Fontenelle, the author of the celebrated work on the *Plurality of Worlds*, had nearly completed his hundredth year when he died. He expired exclaiming, "Je ne souffre pas, mes amis; mais je sens une certaine difficulté d'être."

The inscription on the monument of Leibnitz on the esplanade at Leipzig is, "Ossa Leibnitii" (the bones of Leibnitz).

James Bernoulli I., who died at Basel, after the example of Archimedes, ordered that one of his discoveries should be engraved on his tomb. It was a drawing of the logarithmic spiral, with the inscription "Eadem mutata resurgo" (changed, I rise again the same); a double allusion, first, to his hope of a resurrection; next, to the remarkable properties of the curve, well known to mathematicians, which consist in this, that many operations which in most instances convert one curve into another, in the logarithmic spiral only reproduce the original!

John Bernoulli was not distinguished for amiability. "One day he proposed to his son Daniel, then a youth, a little problem to try his strength; the boy took it with him, solved it, and came back expecting some praise from his father. *You ought to have done it on the spot*, was all the observation made, and with a tone and gesture which his son remembered to the latest day of his life."

When La Caille went to the Cape of Good Hope, in 1751, to make his catalogue of southern stars and measure a degree of the meridian, he received for his expenses, and those of a clockmaker who accompanied him, all instruments included, 10,000 francs. He remained nearly four years, and so accurately did he keep his accounts, that he was able to explain his expenditure to a sou: it was 9,144 francs and 5 sous, and he insisted on returning the balance, in spite of the disinclination of the officers of the treasury to receive it.

The early proficiency of Clairvaut in mathematics is well attested and surprising. He is said to have begun his celebrated treatise on *Curves of Double Curvature*, when only thirteen years old. It appeared when he was eighteen years of age, but was ready for the press two years before. He read the *Conic Sections* of De l'Hôpital, and also the *Infiniment Petits* of the same author, when he was only ten years old; and at the age of twelve presented a memoir on some remarkable curves to the Academy of Sciences, and removed all doubts as to its authorship by his personal explanations.

"Clairvaut and D'Alembert were rivals in their scientific labours, and though their disputes never passed the bounds of courtesy, the life of each, with respect to the other, was either armed truce or open war. The characters of the two were essentially opposite; Clairvaut was a man of the world, of high polish, and who took great care never to offend the self-love of anyone; D'Alembert was blunt and rude, though essentially well-meaning and kind; if we may use such a colloquial phrase, he 'stood no nonsense;' 'J'aime mieux être incivil qu'ennuyé' was his avowed maxim. Clairvaut was always in the world, desirous to shine, and to unite the man of fashion with the philosopher, of all which D'Alembert was the reverse. The attacks usually came from the latter, confined entirely to the writings of his opponent; and he was frequently right, being a thinker of a more safe and cautious order than Clairvaut, who was more than once too hasty. . . The preceding comparison is drawn from Bossut (*Hist. des Math.*), who was the personal friend and the decided eulogist of both. He adds, that the polished character of Clairvaut procured him an *existence* and a consideration in the great world, which talent alone would not have sufficed to gain; and more than insinuates that dissipation destroyed his constitution."—*English Cyclopædia.*

When J. H. Lambert, the distinguished German philosopher, was a youth, he spent a great part of each night in reading such of the Roman authors as he could procure, or in studying arithmetic and geometry; the money for the purchase of the books, and even of the candles by whose light they were read, being obtained, it is said, by the sale of drawings which he found time to execute.

Assyrian Astronomy.—" Behind the harem was an enormous tower or pyramid in seven stages nearly fifty yards high. Remains of similar constructions have been found at Nimrud (Calah) and Kileh Sherghat (Elassar); and there seems no doubt that they were attached to every Assyrian palace, for the inscriptions frequently mention the one belonging to the palace at Nineveh. The seven stages, equal in height, and each one smaller in area than the one beneath it, were covered with stucco of different colours, and thus presented to view the colours consecrated to the seven heavenly bodies, the least important being at the base: white (Venus), black (Saturn), purple (Jupiter), blue (Mercury), vermilion (Mars), silver (the Moon), and gold (the Sun). This was the ancient staged pyramid of the first Semitic Chaldean Empire, adopted and but slightly modified by the Assyrians, by giving a rather smaller base and less difference between the relative sizes of the stages, so as to make it resemble rather a tower than a pyramid. But buildings of this kind, called Zikurat, and so frequently mentioned by the kings in their annals as having been erected by them, were not used in Assyria for temples, as they had been in Chaldæa under the First Empire, and as they continued to be used in Babylon down to the destruction of the city. The sanctuary crowning the summit of the Chaldæan pyramids had disappeared. The Assyrian Zikurat was simply an observatory, and on its summit the priestly astrologers, pupils of the Chaldæans, attempted to read the future in the stars. Astronomy had, in fact, quickly degenerated into astrology in Chaldæa; the belief in the direct influence of the stars on terrestrial affairs was one of the most deeply-rooted articles of faith in Babylon, and had passed into Assyria. The Ninevite kings, like those of Babylon, undertook no enterprise without first consulting the presages of the stars, and for this purpose they always had, within reach in their palaces, astrologers and an observatory. We have already seen that Sennacherib himself says that he gave up an expedition, undertaken with every chance of success, and declined a decisive battle when everything seemed to promise him a victory, because the stars did not seem favourable. We have also stated the influence that, according to the monuments, two eclipses exercised, the one on the accession of Asshurbanipal, the other on that of Sargon. The royal astrologers kept a constant watch from the height of the Zikurat on the state of the heavens and the movements of the stars, so as to interpret them by the aid of the astrological tables so often mentioned in the inscriptions. They furnished the king with an account of their observations; and some tablets bearing reports of this kind were found in the archives of the palace of Koyundjik. As an example, one of them records the observation of the exact day of the spring equinox: 'On the 6th of the month Sivan the day and the night were equal, six double hours for the day and six double hours for the night. May Nebo and Merodach protect my lord the king.' Another, on a tablet in the British Museum, still unpublished (marked K., 86): 'To the founder of buildings, my lord the king, his humble servant, Naboiddin, chief astrologer of Nineveh. May Nebo and Merodach be propitious to the founder of buildings, my lord the king. On the 15th of the month we have observed the entry of the moon into the lunar node and the result. The moon was eclipsed.' Another, in the same collection (marked K., 78), runs thus: 'To the king, my lord, his humble servant Ishtar . . . . chief astrologer of Arbela; peace to my lord the king. May Nebo, Merodach, and Ishtar of Arbela be propitious to my lord the king. On the 29th of the month Sivan we observed the lunar node, but we have not seen the moon. The 2nd of the month Duz, in the year of Belsan, governor of the city of Hirmirdan.' It follows from this last inscription that the Assyro-Chaldæan astrologers, not able to calculate eclipses of the sun, watched attentively at each new moon to see whether one would occur."—*Ancient History of the East*, by Lenormant and Chevallier, vol. 1, pp. 463-64.

VARIABLE STARS.

Approximate times of minima and maxima of variable stars, which according to statements made by Schoenfeld and Winnecke may be expected in April.

1871.		G. M. T.			A. R.			Place of star 1855. Decl.		Magn.
April	h.			h.	m.	s.		°	′	
1 ...	10·8	S Cancri	min.	8	35	39	+	19	33·2	10
2 ...		R Vulpeculae	„	20	57	56	+	23	14·9	13
3 ...	12·7	Algol	„							
6 ...	9·5	Algol	„							
— ...	11·0	δ Librae	„							
8 ...		T Cancri	„	8	48	23	+	20	24·1	11
9 ...	6·3	Algol	„							
— ...		R Ceti	max.	2	18	38	—	0	50·1	8
— ...		S Leonis	„	11	3	21	+	6	14·9	9
10 ...		R Serpentis	„	15	44	1	+	15	34·6	6
13 ...		R Tauri	„	4	20	21	+	9	50·1	8
— ...	10·5	δ Librae	min.							
— ...		S Aquilae	„	20	4	57	+	15	11·5	11
16 ...		S Scorpii	max.	16	9	2	—	22	31·9	9
20 ...	10·1	S Cancri	min.	8	35	39	+	19	33·2	10
— ...	10·1	δ Librae	„							
— ...		T Capricorni	max.	21	14	0	—	15	46·4	9
23 ...		S Herculis	min.	16	45	18	+	15	11·4	12
— ...		R Aquarii	max.	23	26	19	—	16	5·3	6
25 ...		S Vulpeculae	„	19	42	27	+	26	55·7	9
27 ...	9·6	δ Librae	min.							

THE PLANETS FOR APRIL.

At Transit over the Meridian of Greenwich.

Planets	Date	Right Ascension	Declination	Diameter	Meridian Passage
		h. m. s.	° ′		h. m.
Mercury	1st	0 58 17	+5 39	5″·2	0 20·6
	15th	2 38 16	17 31	6″·4	1 5·3
Venus	1st	2 24 35	+14 26	11″·4	1 46·7
	15th	3 32 3	19 53	12″·0	1 58·9
Mars	1st	11 44 7	+5 11	16″·8	11 4·7
	15th	11 29 9	6 10	15″·8	9 54·7
Jupiter	1st	5 17 48	+22 55	34″·0	4 39·4
	13th	5 25 50	23 4	33″·0	4 0·3
Saturn	1st	18 41 47	−22 18	15″·0	18 1·2
	15th	18 42 46	22 17	15″·6	17 7·2
Uranus	3rd	7 37 43	+22 5½	4″·0	6 51·1
	15th	7 38 10	22 4	4″·0	6 4·4

Mercury, during the latter part of the month, may be seen in the evening, but is not well situated for observation until the end of the month, when the planet sets about two hours after the Sun.

Venus is getting into a good position for observation; at the end of the month she sets over 3h. after sunset.

Mars is still in an excellent position, being visible till a short time before sunrise.

Jupiter is visible through the night till the 14th, after which he sets before midnight.

Saturn can be seen in the morning, and rises 2h. before sunrise at the beginning of the month, the interval increasing to over 4h. at its close.

Uranus is well worth observing.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To December 1870.
Williams, Rev. W. O.

To April 1871.
Knobel, E. B.
Linwood, Rev. W.

To June 1871.
Freeman, D. A.
Rivaz, Miss
Williams, Prof. M.

To July 1871.
McAdam, J. V.

To December 1871.
Birmingham, J.
Hunt, G.
Lewis, R. T.
Parnell, J.
Smyth, Prof. C. P.

March 23, 1871. Subscriptions after this date in our next.

NOTICES TO CORRESPONDENTS.

The Title-page and Index to Vol. viii. are in preparation, and will shortly be delivered to Subscribers.

ASTRONOMICAL OCCURRENCES FOR APRIL 1871.

DATE		Principal Occurrences		Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m. Moon
Sat	1		Sidereal Time at Mean Noon, 0h. 37m. 36·9s.			9 8·4
Sun	2		Meridian Passage of the Sun, 3m. 42·13s. after Mean Noon			9 59·1
Mon	3	11 59 12 56	Near approach of Moon to ν Virg. (4½) Conjunction of Moon and Mars, 1° 58′ S.			10 49·5
Tues	4			1st Tr. I. 2nd Oc. D. 3rd Oc. D.	12 4 12 5 12 23	11 40·1
Wed	5	2 22·8 13 21	○ Full Moon Near approach of Moon to 80 Virginis (6)	1st Oc. D.	9 20	12 31·5
Thur	6			2nd Tr. I. 1st Sh. I. 1st Tr. E. 2nd Sh. I. „ Tr. E. 1st Sh. E. 2nd Sh. E.	6 52 7 46 8 50 9 12 9 34 10 2 11 57	Mars 10 38·8
Fri	7	13 17 13 52 15 1 15 8 16 16	Near approach of Moon to ζ¹ Libræ (4) Occultation of ζ³ Libræ (6) Reappearance of ditto Occultation of ζ⁴ Libræ (6) Reappearance of ditto	1st Ec. R.	7 15 46	10 33·7
Sat	8	11 27	Occultation reappearance of ψ Ophiuchi (5)	3rd Sh. I. „ Sh. E.	7 19 10 12	10 28·7
Sun	9					10 23·7
Mon	10	13 52 20 55	Occultation reappearance of 24 Sagittarii (6) Conjunction of Moon and Saturn, 1° 20′ N.			10 18·8
Tues	11	7 51·3 9 3	☾ Moon's Last Quarter Conjunction of Neptune and the Sun			10 13·9
Wed	12		Saturn's Ring: Major Axis = 38″·32 Minor Axis = 16″·29	1st Oc. D.	11 20	10 9·0
Thur	13			1st Tr. I. 2nd Tr. I. 1st Sh. I. „ Tr. E. 2nd Sh. I. 1st Sh. E.	8 33 9 38 9 40 10 49 11 50 11 57	10 4·2
Fri	14			1st Ec. R.	9 11 27	9 59·5
Sat	15		Illuminated portion of disk of Venus = 0·854 of Mars = 0·969	2nd Ec. R. 3rd Tr. E. „ Sh. I.	9 0 48 9 41 11 19	9 54·7

DATE			Principal Occurrences	Jupiter's Satellites		Meridian Passage
		h. m.			h. m. s.	h. m.
Sun	16		Sidereal Time at Mean Noon, 1h. 36m. 45·2s.			9 50·0
Mon	17		Meridian passage of the Sun, 0m. 25·37s. before Mean Noon			9 45·4
Tues	18					9 40·8
Wed	19	7 3·4	● New Moon			9 36·3
Thur	20	22 37	Conjunction of Moon and Mercury, 6° 21′ N.	**1st** Tr. I. „ Sh. I.	10 32 11 35	9 31·8
Fri	21	0 43	Conjunction of Venus and A^1 Tauri (4m. 6) W.	**1st** Oc. D. „ Ec. R.	7 50 11 7 4	9 27·4
Sat	22	9 34 3 21	Near approach of Moon to B.A.C. 1361 Conjunction of Moon and Venus, 3° 38′ N.	**1st** Tr. E. „ Sh. E. **3rd** Tr. I. **2nd** Ec. R.	7 18 8 21 11 9 11 36 15	9 23·0
Sun	23	21 22	Conjunction of Moon and Jupiter, 0° 37′ N.			9 18·6
Mon	24	0 19 9 8	Conjunction of Venus and υ^1 Tauri (1m. 8) E. Conjunction of Venus and υ^1 Tauri, 0°.6′ S.			9 14·3
Tues	25					9 10·1
Wed	26	7 9	Conjunction of Moon and Uranus, 1° 17′ S.	**3rd** Ec. R.	8 12 37	Moon — 5 17·9
Thur	27	11 47·7	☽ Moon's First Quarter			6 8·3
Fri	28			**1st** Oc. D.	9 50	6 58·4
Sat	29			**1st** Tr. E. **2nd** Oc. D. **1st** Sh. E.	9 18 9 37 10 16	7 47·9
Sun	30	14 24	Conjunction of Moon and Mars, 3° 17′ S.	**1st** Ec. R.	7 31 26	8 37·2
May Mon	1			**2nd** Sh. E.	9 10	9 26·5

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN APRIL 1871.

By W. R. Birt, F.R.A.S.

Day		Supplement ☾ − ☉ Midnight		Objects to be observed
		° ′		
1	...	47 0	...	Kepler and its ray system.
2	...	34 29	...	Flamsteed, Letronne, Hippalus.
3	...	21 31	...	Sersalis, Fontana, Cavendish.
4	...	8 10	...	Region about the S. Pole.
21	...	155 38	...	Hansen, Alhazen, Oriani.
22	...	144 46	...	Burckhardt, Seminus, Messala.
23	...	133 58	...	Endymion, Warren De La Rue.*
24	...	123 9	...	Lithrow, Vitruvius, Jansen.
25	...	112 15	...	Theophilus, Cyrillus, Catharina.
26	...	101 12	...	Rhæticus, Linné, Stöfler.
27	...	89 54	...	Apennines, Aristillus, Autolycus.
28	...	78 17	...	Hell, Maginus, Moretus.
29	...	66 14	...	Laplace, Maupertius, Condamine.
30	...	53 45	...	Mare Humorum, Doppelmayer, Vitello.

The objects specified for February, p. 48, will be nearly similarly illuminated in April. The position of the terminator with regard to each may be easily ascertained from the table given on pp. 46 and 47. In April the sun will be between the winter solstice and vernal equinox, moon's N. hemisphere.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator and of 60° of northern and southern selenographic lat., where the sun's centre rises or sets.

Greenwich, midnight.			60° N.		0°		60° S.
					Sunrise:		
			°		°		°
1871. April	1	...	−47·3	...	−50·0	...	−52·6
	2	...	59·5	...	62·1	...	64·8
	3	...	71·7	...	74·3	...	76·9
	4	...	−83·8	...	−86·5	...	−89·1
					Sunset:		
	5	...	+78·8	...	+81·4	...	+84·0
	6	...	66·6	...	69·2	...	71·8
	7	...	54·4	...	57·0	...	59·6
	8	...	42·3	...	44·9	...	47·5
	9	...	30·1	...	32·7	...	35·3
	10	...	18·0	...	20·5	...	23·1
	11	...	+ 5·8	...	+ 8·3	...	+10·9
	12	...	− 6·4	...	− 3·9	...	− 1·3
	13	...	18·6	...	16·1	...	13·6
	14	...	30·8	...	28·3	...	25·8
	15	...	43·0	...	40·5	...	38·0
	16	...	55·2	...	52·8	...	50·3
	17	...	67·4	...	65·0	...	62·6
	18	...	−79·6	...	−77·2	...	−74·8

* A fine formation on the same meridian west and north of Endymion. It is larger, and includes "Strabo." It is well seen as the moon passes from perigee to apogee.

SUNRISE:

1871. April 20	...	+80°·7	...	+78°·4	...	+76°·0	
21	...	68·5	...	66·1	...	63·8	
22	...	56·2	...	53·9	...	51·6	
23	...	44·0	...	41·7	...	39·3	
24	...	31·8	...	29·5	...	27·2	
25	...	19·5	...	17·2	...	15·0	
26	...	+ 7·3	...	+ 5·0	...	+ 2·8	
27	...	− 5·0	...	− 7·2	...	− 9·4	
28	...	17·2	...	19·4	...	21·6	
29	...	29·4	...	31·6	...	33·7	
30	...	−41·6	...	−43·8	...	−45·9	M.

MARS.

Areographic longitude and latitude of apparent centre of disk, angle of position of axis, diameter, and amount and angle of position of greatest defect of illumination.

1871.	Longitude. 8h.	10h.	12h.	Lat. °	Axis. Gr. midnight.	Diam.	Def. of ill.	
April 1	254°	283°	313°	25·6 N.	26°·0	14·12″	0·12″	123°
2	245	275	304	25·6	25·8	14·08	·14	122
3	237	266	295	25·7	25·6	14·03	·16	122
4	228	257	286	25·7	25·4	13·98	·18	121
5	219	248	278	25·8	25·2	13·93	·20	121
6	210	239	269	25·8	25·1	13·87	·22	120
7	202	231	260	25·9	24·9	13·81	·24	120
8	193	222	251	25·9	24·7	13·75	·26	119
9	184	213	243	26·0	24·6	13·69	·28	119
10	175	204	234	26·0	24·4	13·62	·31	119
11	166	196	225	26·0	24·3	13·55	·34	118
12	157	187	216	26·1	24·1	13·47	·36	118
13	149	178	207	26·1	24·0	13·40	·38	118
14	140	169	198	26·2	23·9	13·32	·40	117
15	131	160	189	26·2	23·8	13·24	·43	117
16	122	151	180	26·3	23·6	13·16	·46	117
17	113	142	171	26·3	23·5	13·08	·48	117
18	104	133	163	26·4	23·4	12·99	·50	116
19	95	124	154	26·4	23·3	12·91	·52	116
20	86	115	145	26·5	23·3	12·82	·54	116
21	77	106	136	26·5	23·2	12·73	·57	116
22	68	97	127	26·5	23·1	12·64	·59	116
23	59	88	118	26·6	23·1	12·56	·61	115
24	50	79	109	26·6	23·0	12·47	·63	115
25	41	70	100	26·7	23·0	12·37	·65	115
26	32	61	91	26·7	23·0	12·28	·67	115
27	23	52	81	26·8	22·9	12·19	·69	115
28	14	43	72	26·8	22·9	12·10	·71	115
29	5	34	63	26·8	22·9	12·01	·73	115
30	356	25	54	26·9 N.	22·9	11·92	0·75	115

THE CENTENARY NUMBER OF THE ASTRONOMICAL REGISTER.

In the open air this evening, the 23rd of March 1871, about seven o'clock, we gazed with all our old delight on the lovely sky. In the East, Mars, red and fiery, was rising. How different to all other objects in the heavens! no wonder the ancients gave him the title applicable to the God of Battles. High above, almost in the zenith, appeared the twins Castor and Pollux, and a little to the West the glorious Jupiter. Below the lovely constellation Orion, and the incomparable Sirius, shone in all its beauty Betelgeuze, and the adjacent Aldebaran shining with similar lustre. We can scarce spare a glance for the misty Pleiades, for there in all their glory are the young moon and Venus. Dazzling the eye in the bright twilight, in which like glorious gems they reign supreme, who could look upon such a wondrous scene without a wish rising to possess more knowledge of the sublime science which treats of them? Can we wonder that the ancients persevered until they became acquainted with so much of the captivating study? It was some such thoughts as these that originated the commencement, more than eight years ago, of our little periodical, intended to assist beginners at the commencement, and to interest them during the progress of their study of astronomy. Since that time numberless scientific serials have arisen, blazed into light, and sunk to rise no more; while our little *Register* has pertinaciously held its way in spite of many adverse circumstances. But when we recall the pleasure we have had in carrying on the *Register*, and the memory of the kind friends who assisted us in its commencement (many, alas! now no more), we do not consider our time and labour wasted. And for the future, if it be considered and admitted that the *Register* does not and cannot depend, like popular periodicals, on a large circulation, that it must be supported by the free contributions and correspondence of the subscribers, and by each one assisting to increase its circulation—under these circumstances it is to be hoped that it may still continue to be of use to those to whom we may be permitted to flatter ourselves it has hitherto proved acceptable. We will not further take up space wanted for more important matters, but we could not resist the temptation of saying a few words on the occasion of our Hundredth Number.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, N.E.*, **not later than the 15th of the month.**

The Astronomical Register.

No. 101. MAY. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Sixth Meeting, April 14th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. Thirty-six presents were announced, and the thanks of the Society given to the respective donors.

Charles Coppock, Esq.,
Capt. W. M. Campbell, R.E., and
James W. Lee Glaisher, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Extract from a letter of the Rev. W. A. Jevons, on the Zodiacal Light: communicated by Mr. Rees.

On Good Friday, about 7h. 4m. in the evening, the writer thinks he saw the zodiacal light. He was at Buxton, and observed a luminous appearance a little north of the place where the sun had set. It was nearly perpendicular: about 1° broad, 5° high, and lasted about 5 minutes.

Mr. Birt observed it on the same evening, but it was much longer. It extended from Aldebaran to ϵ Persei; the apex was very rounded, and terminated near τ Tauri. He saw it again the following Monday.

Mr. Penrose had seen it several evenings in March with considerable distinctness. It was of the same colour as the Milky Way, and on one occasion decidedly brighter.

Messrs. Birt and Penrose both agreed that the Pleiades were quite involved in the luminosity.

Dr. Mann suggested that what Mr. Jevons saw might have been a streamer of an aurora, as the dimensions were so small, and that the obtuseness of the apex in the zodiacal light was due to the amount of twilight, which would blunt the point of the ellipse.

The President remarked that at Malta, where he had seen it very much better than in England, the colour was ruddy.

On a remarkable appearance during the Solar Eclipse of December 22nd, 1870: by Commander Hardy.

The writer has seen no account published of a singular appearance noticed by himself and the Rev. H. Winwood, at Bath. On the day in question the sky was covered with broken clouds, which did not however interrupt the observation of the eclipse. Some time before the greatest phase, a large and brilliantly coloured patch of light was seen about 15° to the east of the sun. The colours were green, purple, and orange, but green predominated. Soon after the greatest obscuration the tints faded, and clouds obscured both the patch and the eclipse.

The President said that it had been suggested by Mr. Main that the writer had probably seen a mock sun, and this appeared a very good explanation.

On the Orbits of the Revolving Double Stars ε Hercules and ε Cancri: by Mr. Plummer.

The author states that several attempts have been made to determine these orbits, but the assumed positions have not agreed with these angles as observed subsequently. The latest of ε Hercules is by Mr. Breen, but there is still discrepancy in position. He (Mr. P.) has therefore made another trial by equations of condition founded on the most recent observations, and obtained elements which satisfy them, from which he has computed an ephemeris from 1870 to 1875, which will test his results. He makes the periastrum in 1866, when the distance was 0·241″, the period 36·06 years, and the mean distance 1·374″. In the determination of the orbit of ε Cancri he has used the elements of Dr. Winnecke, but the distances show considerable discrepancies. The periastrum he finds will be in 1872, with a distance of 0·44″, the period 58·23 years, and the mean distance 0·908″.

Observations on the Planet Amalthea (113); by Dr. Luther.

Calculations to obtain the Earth's Exact Distance from the Sun and Moon, &c: by Mr. Dingle.

Observations and Elements of Winnecke's Comet: by Mr. Hind.

A small comet having been discovered by Dr. Winnecke in Perseus, it was detected at Mr. Bishop's Observatory on April 10. The place was then R.A. 2h. 41m. 40s., and N.D. 52° 26′, with a daily motion of 5 minutes in R.A. and 30′ in N.P.D. There is an extension of nebulosity on the side farthest from the sun, so that a tail may be expected. A good telescope is required to see it. This comet does not seem to be an appearance of any one formerly known. Its perihelion will be June, 1871.

Dr. Huggins had seen it last night. It was very faint indeed, but had distinct indications of a tail. It was just visible in the finder of his large telescope. This finder is of 4 inches aperture. [Dr. H. made a sketch of the comet.]

Letter to Mr. Carrington, on Spectroscopic Observations: by M. Chacornac.

This communication suggested that the line D was a phenomenon of interference due to the jaws of the slit.

Dr. Huggins said that the papers being exhausted, he would hand round a series of drawings of Jupiter he made and presented to the Society about ten years ago. They extended through the years 1858-9 and 60, and were accompanied by a note suggesting that if there were periodic changes in configuration or colour, they would be useful for comparison. One only was coloured, but it might be understood the others had similar tints.

Mr. Carpenter said he had been observing Jupiter with the great Equatorial at Greenwich, and had long been familiar with the reddish colour of the central band. In 1861-2 he made 40 or 50 drawings of the planet, and this colour was then strong. There was a gap in the drawings from that time to 1868, but he was sure that, had any change taken place in the tint, it would have been remarked.

The President had been an observer of Jupiter for a quarter of a century, with telescopes ranging from a 7-inch Gregorian to very large reflectors. He had seen minute white specks, and large round spots on the belts at various times, but these were very ephemereal. With the same telescopes now, and recalling his first impressions, he found the planet about the same as in his early days. Any changes, he thought, were not chronic but cyclonic. His general impression of its form and colour was the same.

Dr. Huggins: When the belts are more distinct at one time than another, of course the colour appears stronger. I do not detect any changes of colour. It appears almost identical with what I saw when my drawings were made.

Mr. Ranyard: Several distinguished observers have thought the colour has changed. Sir Wm. Herschel speaks of it as russet. Mr. Dawes, in 1859, thought Jupiter had altered considerably in colour. Whether the bright egg-shaped spots are always to be seen on the belts, I do not know; but they are most conspicuous now, and are so in Dr. Huggins's sketches. Mr. Dawes saw the smaller white markings, which are the same as in these drawings before us. The central belts have always the same character, but the very small spots occur only on the polar belts.

The President: What I saw were small, round, white spots, like satellites.

Dr. De La Rue: I have observed and made drawings of Jupiter for twenty years, and my experience goes to confirm what has fallen from the President's lips. The colour is one of the earliest things which strikes an observer. It is ruddy in the central bands, and at once forces itself upon the attention. It is found in my drawings. It varies a little, but is not essentially different to what it was twenty years ago. Some persons who begin with small telescopes, which do not display the colouring when they see it with larger instruments, think the planet has changed. There are sometimes great changes in the form of the belts, but in time the configurations recur. There is a great deal of colour in Saturn, Venus, and Jupiter, and more attention is paid to this now than formerly.

The President: Has Mr. Ranyard obtained any evidence of periodic changes?

Mr. Ranyard: There are twenty-six observations of spots, of which three only are stated to be white. These occur within twelve months of the maximum of sun spots. Sir Wm. Herschel's observations of the colour agree with the sun-spot maximum. The black spots do not agree at all with this period. I have no strong evidence at present, but think that the egg-shaped and Dawes's spots coincide with the sun-spot maximum.

The President: Such observations should be continued.

Mr. Ranyard: The broken belts are more frequent lately. They seem to be connected with the sun-spot period.

Mr. Carrington: There is no such connection between sun spots and Jupiter's markings.

Col. Strange: It occurs to me that colour is one of the last things to be trusted. There are four things noticed by the eye—size, form, luminosity, and colour. Of these four the permanence of impression as to colour is least reliable. More persons carry away correct impressions of the other three than of colour. Let any one look at the paper of a room, and go to a paper-warehouse to try and match it, and he will bring home a very bad one. I made this experiment myself lately. Eyes differ so much in estimation of colour that no two should be trusted for comparison unless they have been properly tested. The same eye also differs at different periods of life. The heavenly bodies are much affected by atmospheric conditions, and the observer by conditions of health and other circumstances, so that, unless the evidence were overwhelming, I should not trust to any statements of colour.

Mr. Penrose: I agree as to form being better remembered, but there is a respectable minority I would trust as to colour, especially artists and those who have bestowed great attention on the subject. I admit there is great diversity in eyes, but the same eye and the same object used for many years gives a reliable result. With the same telescope I find Jupiter is not so coloured this year as last, but this may be due to atmospheric changes.

Dr. Huggins: With respect to Mr. Ranyard's remarks, it should be remembered that telescopes have much improved in character during the two or three last sun-spot periods. The telescopes generally used are two or three times as large as those formerly available by the majority of observers, and therefore small spots may be expected to be seen oftener.

Mr. Ranyard: Yet black spots were frequently noticed by the very old observers, such as Cassini and others.

The President: But the minute white spots are much more difficult.

Dr. De La Rue desired to recall the attention of the meeting to another subject—one at which he had worked ardently himself, and was therefore qualified to appreciate devotion to it in others. There happened to be present in the room a gentleman to whose labours in astronomical photography they owed the beautiful pictures of the moon which adorned the walls. He meant Mr. Rutherfurd, of New York. [This announcement was received with great applause.]

Mr. Rutherfurd said, he was not prepared for such a flattering reception, but he had in his pocket a few photographic plates, which he wished to present to the Society. The first was a negative of the sun. This was taken with a refracting telescope, corrected for the actinic rays, and not for vision. He had spent many years over the adaptation of photography to the celestial bodies. His first expedient to get the chemical rays to a focus was by interposing a lens between the object-glass and the sensitive plate; but he found that this only produced correction in the centre of the picture, and that the edges were confused. About ten years ago, when the discoveries of Kirchhoff and Bunsen were made known, he applied a spectroscope to the stars, and found this gave him an unerring test of the state of the corrections of his telescope and the means of completing such correction. He would explain this by a diagram. If all the rays from a star converged to a focus, that would be a point; and if that point were received on a prism, it became a line, with one end red and the other violet; but if the rays had not met at one point, the spectrum would be not a line, but a brush. An inspection, therefore, of the lines of the spectrum showed which were not parallel, and he was enabled to correct any out-standing errors, till he got his spectrum of the proper character. A moment's inspection of the spectrum of Sirius or α Lyræ (other stars did not give light enough) now enabled him to correct his telescope. Having corrected the object glass for colour, the next point was the figure. Mathematical calculations would give the formulæ, but these could not be carried out directly. The only means available was a tentative process. He, therefore, had to mount his telescope with great accuracy, and get his clock to carry it six or eight minutes quite steadily. He then took numerous pictures in and out of focus, and comparing their defects and making alterations, at last corrected his object-glass to his satisfaction. He then proceeded to work. His object was not only to obtain pictures of the moon, such as those presented by Mr. Buckingham, but to make the stars record their own position for all time. He attacked the *Pleiades* first. His plan was to take a plate and expose it to the stars for several minutes, during which the clock worked most accurately. The light was then shut off, and another picture taken to identify the stars, and thus see which were stars and which were pin-holes, which so annoyed photographers generally. The clock was then thrown out of gear, and each star then made a track along the plate, forming a base line, by which positions could be most accurately measured. One of his plates of the Pleiades he presented to the Society. [The stars were wonderfully sharp in this negative.] He had found that the greatest amount of sensibility of the plates was secured by exposing them to a little light before insertion in the apparatus—just sufficient to produce a slight fogging if then developed. The chemicals seemed to be in a very unstable state of equilibrium, and this induced a commencement of action which was carried on by the stars. As to the sun, he used a camera body, attached to the telescope, with a stop at the point in the cone of rays, where it was only $\frac{1}{10}$th of an inch in diameter. The effect of a narrow line in his slide was, however, to produce distortion. He then tried slower chemicals and a larger aperture. Dry plates gave the best results, but there were many difficulties in their use, and he had now returned to the ordinary wet ones. In his experiments to avoid distortion, he had used ruled plates to measure spaces in different parts, and could readily detect what distortion had been produced. He had done all in his power to ensure correct results. He had discarded the wooden tube of the telescope, which played all sorts of vagaries, and he used now a galvanized iron one, which was ugly but worked well. It must be remembered that you could not focus on the plate by the eye, so that after having found out by experiment the right point of focus at a certain temperature, he placed thermometers all along the tube, and made the necessary allowance in focal length for any other temperature. The tube was a closed one, but there were three ventilating openings in it. If the observatory were very hot, these were opened, and the telescope left till the temperature inside and out became uniform. The plate for photographing the stars must be properly collimated, or the measures would be wrong. To do this he covered a plate all but the centre, and also the object-glass; and then, if the image of the flame of a candle projected by the object-glass on the plate were perfect, there would be no distortion of half a hundredth of an inch. Having obtained his photographs, the next thing was to utilize them; and for this purpose a micrometer was required. Had he known the one invented by Dr. De La Rue, for measuring the solar photographs, it would have saved him much trouble, but not being aware of it, he constructed one having a divided circle, and a glass stage above it, on which the photograph was placed. Then a compound microscope, carried by a sort of slide-rest, and worked by a very delicate screw, made the measures. The results were excellent, and superior to those of Bessel's heliometer. He instructed a lady to make these measures, and found her quite competent for the work. Ten measures were taken of each position. Dr. Gould had reduced some of the results, and found them very flattering to the method. He (Dr. Gould) stated that one plate was equal to a year's observations by the eye in the usual manner. These observations had not yet been published. In the course of some years' work the micrometer screw had become worn, and the error had increased lately. It would be possible to introduce an average correction for each year, but he had now discarded the screw, and remodelled the instrument on Dr. De La Rue's plan, using a sort of straight-edge slide. It was necessary to find the value of the screw. One method which was first tried was very fascinating, but did not give such good results as others. It depended on a screen or fan placed between the object-glass and the plate, and being moved rapidly by clock-work, had its motion stopped every second by the sidereal clock. The telescope being placed on a star near the meridian, the plate received a succession of pictures of the star, and from its motion in a second the value of the intervals could be deduced. An exposure of several minutes gave better results than an instantaneous one. Another plan was arranged with Dr. Gould, by taking pairs of stars having nearly the same declination. Dr. Gould recorded the transits with his large instrument, and Mr. Rutherfurd took pictures of the same pairs, which were afterwards compared. The best result was, however, obtained by taking transits of stars upon plates having lines ruled in different parts. In this operation the aperture was reduced to two inches. With respect to moon photographs, he would mention that by mounting two pictures, so that they could be revolved, he found that in one position they gave a stereoscopic effect; and in another, a pseudoscopic one, looking like a picture in a crystal basin. This slide he would leave with the Society. [Cheers.]*

The President said he was sure all present would join him in recording their grateful thanks to Mr. Rutherfurd for his admirable account of the progess made in adapting photography to practical astronomy.

Dr. De La Rue: Our visitor's efforts have been directed, not merely to produce fine pictures of the moon, but to furnish astronomers with unerring records by which to test future progress and astronomical changes. Our great enemy in photographic operations is the atmosphere. Other difficulties can be overcome, but this continually beats us. I am in hopes that photography will some day settle the question of the *physical libration* of the moon—that is, whether there is any real balancing or swinging to and fro. The other librations can be allowed for; and the one in question, if existing, I believe will be detected. The angular diameter of the sun is another matter more amenable to photographic measures; and they should, I think, be greatly preferred to those made with ordinary instruments. Allowance can be made for any little optical distortion; and I expect the ten years' Kew observations will throw light on this subject. The sun's diameter may not be always the same. The prominences are known to be in a state of constant alteration as to height, and the mobile photosphere may do the same. The effect of distortion by the lens was obtained at Kew by placing objects on the Pagoda there, and photographing them on different parts of the plate in the way I have described on a former occasion. I feel sure that astronomical photography has only to be

* The above is but a sketch of Mr. Rutherfurd's lucid and interesting explanation of his processes, which was so constantly illustrated by diagrams he made, as he proceeded, that further detail without these would be unintelligible.

pursued steadily to achieve far greater results than have hitherto been obtained, and has a brilliant future before it; and I desire to record my admiration of Mr. Rutherfurd's most successful labours.

Mr. Rutherfurd said, Dr. De la Rue had prophesied a hopeful future for photography, which he trusted to find realised. He should like to mention that the pictures of the moon were taken with an object-glass of 11½ inches aperture, specially corrected for the chemical rays, but he now used an ordinary achromatic of 13 inches aperture, which could be converted into a photographic lens in five minutes, by slipping a meniscus of flint glass in front of it. This altered the focal length, for which arrangements were made at the tail-piece. He would also remark that the outline of the moon on the circular side was not uniform. His friend at the head of the United States Coast Survey, was very fond of occultations for determining longitudes, but found discrepancies on this account, and he (Mr. R.) photographed the moon on many of these occasions, and could see the minute deviations in outline. The sun's outline looked sharp and clean, but that of the moon was not so. In the American photographs of the eclipse of 1869, she did not look perfectly round on the sun's disk. The dimensions of the sun were different according to the time of exposure. The light fell off so rapidly towards the edges, that there might not be time to produce a complete image. If pictures were taken with different apertures, it would be found that the greater gave diameters many seconds larger than the small. This might account for the differences noticed in observations of the transits of Venus and Mercury.

M. Jansen was also present at the meeting, and at the President's request, gave an account of his attempt to observe the late Solar eclipse in Algeria, and made some remarks on the nature of the corona.

The meeting then adjourned.

THE INDIAN ZENITH SECTOR.

Sir,—I trust you will afford me a little space to make a few observations and explanations with respect to Captain Herschel's letter on the above subject. The letter speaks of the "extraordinary mistakes," and "unmeaning extracts," contained in the report of Colonel Strange's paper, brought before the November Meeting of the Royal Astronomical Society, as printed in your periodical, for which I am responsible; and I hope to show that, so far as my share of the matter is concerned, such language is hardly justifiable. It is probable that Captain Herschel and many of your readers are not aware of the difficulties under which reporting is carried on at Somerset House. The Society makes no provision for the accommodation of reporters, who have therefore to work with note-book in hand, and without sufficient elbow room. They have no access to the papers, and are entirely at the mercy of the secretary or author who may read a paper, as to how much he thinks proper to give, and it is obvious that of this portion only can any abstract be communicated to the public in your journal. As a rule, therefore, all that can be done, is to give a general idea of the contents of the papers, which, as they are subsequently printed in *The Monthly Notices*, are seen *in extenso* by all interested in the subjects; while every effort is made to report the discussions as fully as possible, as the observations then made, which are often more valuable than the papers that originate them, would otherwise be entirely lost. It should also be mentioned that the paper by Colonel Strange came on at a late hour of the evening (in fact it was the last paper), and the author, instead of reading it, gave an oral synopsis of its contents, and did not even read the extracts the paper contains from Captain Herschel's letter, but merely quoted the leading points from memory, aided by an occasional glance at the MS. He is so careful and deliberate a speaker, and so easily followed, although I do not write shorthand, that I think I may safely say that anything I find upon my notes was actually said, although it may not be the *whole* of what was said. With these preliminary observations, I proceed to notice Captain Herschel's paragraphs in detail.

1. There is evidently a mistake here as to Captain Herschel having measured a base line at the dates mentioned, but the operation was certainly referred to by the speaker. The dates given appear to be the beginning and ending of the letter, but it is commenced at "Coimbatore Base," and the speaker may have casually indicated that his correspondent was so engaged. However, as Captain Herschel remarks, his engagements at the moment have nothing whatever to do with the subject of his letter.

2. I find the word "closing" so distinctly written in my notes, and another word struck out in its favour, that I can hardly doubt it was really uttered. It is certainly printed "choosing" in *the Monthly Notices*, but as the paper also goes on to mention the "twenty-four distinct operations, consisting of settings, readings, intersections, and reversals," which I also reported as having to be done in the five minutes allowed, I cannot but think "closing" might have been used by Colonel Strange as more expressive of the work to be done in the time than the "choosing" of the writer of the letter, which to most persons would hardly seem to include actual observations with the instrument.

Paragraphs 3, 4, 5, 6, and 7, admit the accuracy of my report of the expressions used as far as given, but supplement them by important explanations. As to paragraph 5, I find that the word "generally" was used in stating the errors of each triplet were within 1″. The additions by Captain Herschel are doubtless most valuable, but as they were not read at the meeting, I had no means of including them in the report, the official publication of the paper not taking place till long after the *Astronomical Register* is out. It will be seen that Colonel Strange gave some illustrations of the accuracy of the division of the circles, which are his own calculations, and not included in Captain Herschel's letter or the paper as printed; and he also made other remarks not in his paper, showing that he spoke extempore, and did not read exactly what he had written; and the presumption therefore is, that I noted what he did really say, and could do no more without seeing the paper.

However, I think it fortunate for the readers of the *Register* that Captain Herschel has been induced to add his interesting and important explanations to the report, for which they cannot but feel most grateful; and I trust that they will also allow that the account of the paper is as good as possible under the difficult circumstances attending its communication experienced by

April 14, 1871. YOUR REPORTER.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

RIGHT ASCENSION OF URANUS:

Sir,—Perhaps it may interest some of your readers to know the amount of difference between the observed and tabular right ascension of Uranus, as other observers besides Capt. Noble may have been disappointed to find that at the occultation of March 2, the planet had disappeared some minutes before the calculated time. At the meeting of the Royal Astronomical Society, on March 10, I mentioned that the true right ascension of Uranus was about 15 seconds less than that given in the *Nautical Almanac;* and that consequently the disappearance must naturally have taken place some minutes before the time obtained direct from the tables. In the abstract of the proceedings of the Society, contained in the April number of the *Register*, this difference is wrongly printed, 15 seconds of arc, instead of 15 seconds of time, which may probably mislead some one.

The following numbers are the differences between the observed right ascension and that inserted in the *Nautical Almanac.* The sign + signifies that the tabular place is too great.

Year.			Tabular R.A.—Observed R.A.
			s.
1867	...	...	+ 15·6
1868	...	...	15·4
1869	...	...	14·9
1870	...	...	14·4
1871	...	...	+ 13·8

On March 2, 1871, at 15h. M.T., the increase of the Moon's right ascension in one minute was 2·27s. As the true right ascension of Uranus was nearly 14 seconds less than the *N. A.* right ascension, the true time of disappearance at the Moon's limb would be about six minutes before the calculated time—an interval quite sufficient to cause the disappointment felt by observers after sitting up to so late an hour.

The only tables available for the calculation of the tabular places of Uranus, are those of Bouvard, published at Paris so far back as 1821.

I am, Sir, your obedient servant,

EDWIN DUNKIN.

April 6, 1871.

MOCK SUNS AND MOONS.

Sir,—The Rev. T. W. Webb, in his letter in the *Register* for March, referring to the above subject, states : "*A season of frequency may possibly now have commenced, and many of your readers may be interested in keeping watch for both solar and lunar appendages of this nature.*" Since his reply to my letter, I have been looking out for this interesting phenomenon ; and on April 6th I had the pleasure of witnessing both. At half-past 5 o'clock in the evening, the sun was surrounded with a halo about 70° in diameter, the lower part of which was hid below the horizon. There was a vertical strip of white light proceeding from the upper and lower limb of the sun. On the northern side of the sun, on the halo, appeared a parhelion, which lasted a quarter of an hour. At 6 o'clock a brilliant parhelion appeared on the upper part of the halo where the white strip of light terminated. Its form was nearly circular, and its apparent diameter a little greater than that of the true sun ; two beams of light shot out from the upper part of the parhelion at angles of 45°. This beautiful phenomena continued above half an hour. I drew the attention of a farm-labourer to this phenomena, and he stated, "This is what I have not seen for many years. Those bright spots on the ring we call *sun galls*, and when they appear afar off rain will soon come."

The same evening, at 8 o'clock, a halo appearance around the moon about 50° in diameter, and paraselenæ appeared on the halo on the southern side of the moon, but was not very bright. A vertical strip of white light proceeded from the upper and lower limb of the moon also.

Yours respectfully,
J. WEBB.

Wiveliscombe, Somerset:
April 8, 1871.

DARWINISM AND ASTRONOMY.

To the Editor of the *Times.*

Sir,—After the many solid arguments adduced in your late admirable and most welcome notice of Mr. Charles Darwin's recent work, I should like to make only one suggestion. Mr. Darwin's theory requires us to believe that animal life existed on this globe at a period when, according to a theory much more plausible than his, the earth and all the planets with the sun constituted but one diffused nebula. Astronomers really have some *data* on which to found this theory of theirs, since marked variations in the conformation of several nebulæ within historic times are now on record ; whereas all the variations which Mr. Darwin has been able to point out in species, and especially in man, within the same limits of time are either zero, or of an extremely nebulous character.

I remain, Sir, yours faithfully,
ASTRONOMICUS.

April 10.

THE ROYAL SOCIETY'S NEW TELESCOPE.

Daily Telegraph, 14th April.

The pursuit of science is rapidly passing out of the range of private resources. For many of the more important branches of research, the instrumental and material requirements are beyond the supplying powers of individual purses. This is especially true of astronomical investigations, which, to be carried on nowadays with any hope of valuable results, necessitates the employment of telescopes, the fabrication of which involves the outlay of little fortunes. Time was when four or five hundred pounds would give an astronomer a telescope and appurtenances with which he might hope to advance the science of his adoption. But now, although much useful work remains to be done with such comparatively moderate instruments as can be purchased for the sum just named, he who desires to open new and wider fields of celestial study must be prepared to pay in thousands for the optical key. To give an idea of the value of great telescopes, we may mention that the large refractor added a few years back to the Greenwich Observatory, cost, with all its complexities of mounting, a sum exceeding ten thousand pounds, and that half this sum was recently paid by the Government of Victoria for a reflector of 4-feet aperture that has been set up at Melbourne.

In view of the fore-mentioned circumstances, it will be acknowledged that the Royal Society did a wise thing in devoting a legacy that lately fell to it, to the purchase of a large astronomical telescope, to be placed at the service of some ardent amateur, competent to use such an instrument to the best advantage. The bequest alluded to was a sum of 1,500*l.* left by the late Benjamin Oliveira, to be expended upon such a scientific object as the Council of the Society should deem worthy and appropriate. The suggestion for its astronomical dedication came from Dr. Robinson, the well-known astronomer of Armagh, and in adopting his proposal, the Society made up the sum to 2,000*l.* Estimates were sought from several English and Continental instrument makers, and the result was that the work of constructing the telescope went into the hands of Mr. Grubb, of Dublin, who was then completing the large reflector for the Melbourne Observatory, to which we have just made allusion.

The telescope decided upon and now completed is an equatorial refractor. The size of the object-glass, 15 inches, is imposing. Until within the past two or three years, there were but two glasses of such a size in the world; one was at the Russian Observatory at Pulkova, the other was in the United States, at Harvard College. Lately, however, attempts have been made to surpass considerably this diameter, Mr Cooke, of York, having, at a great cost—borne by Mr. Newall, of Gateshead—attempted and accomplished the working of an achromatic lens 25 inches in diameter, and Mr. Buckingham having recently made one of 21 inches diameter. As yet we have heard of no trials of these glasses which could determine how far the inconceivable difficulties of figuring larger lenses have been overcome.

The Royal Society's object-glass is remarkable for the shortness of its focus, which is only 15 feet. The design of this shortening is to secure great concentration of light—a principal intended use of the instrument being for the spectroscopic analysis of the light of the fainter stars and nebulæ. By the large area of the lens, a great amount of light from any object under view will be grasped, and by its shortness of focus that great amount will be condensed upon a very small space, and thus great brilliancy will be secured in objects of sensible size, like planets or nebulæ; for stars it is of no importance, since a star appears but as a point in any telescope. Every schoolboy knows that the burning-glass which acts best is a large one that has a short focus, and that, consequently, gives a small and intensely brilliant image of the sun. The concentration that the schoolboy wants for sport the spectroscopist requires for science.

During the discussion upon the telescope, and before its construction was actually decided upon, the question naturally arose, into whose hands should it be placed? Considering that the branch that at the present time requires the greatest fostering, and promises the grandest results in return, is the new science of spectrum analysis, it was quite natural that the first thoughts of the initiators should be turned to the father of spectroscopy, Dr. Huggins, to whom astronomy is indebted for advances comparable in importance to those that have made the name of Herschel immortal. To him, accordingly, the telescope was spontaneously offered. A wiser offer could not possibly have been made, and it was curiously well-timed, for Dr. Huggins was then concluding an engagement with a maker for the purchase, at his private cost, of a large instrument to replace the one of 8-inches aperture, with which his high reputation has been earned. He accepted the Royal Society's offer, upon the conditions that he should retain the instrument during the time he might be willing to devote it to spectroscopic or other astronomical researches, and that he should be free to select working subjects of his own choice. His well-known zeal and character were guarantees that the best possible use would be made of it. He thus became a party to the construction. He decided upon plans and details, and forthwith erected an observatory to receive it, at an outlay of about 500*l.*, and within the past few weeks it has been duly installed therein. We have had an opportunity of inspecting it, and of judging upon the optical performance of its object-glass. To say that the instrument is mounted with high engineering skill, that it possesses great stability, with such an ease of motion that a child could with one hand direct it to any part of the sky, that it has a competent driving clock, and all the perfect minutiæ that experience could suggest, is but to state matters of course. Technical details would be out of place here. The containing dome, with its shutters opening for view of any part of the heavens, has been constructed with some taste, and with conditions of comfort that many an astronomer who visits Dr. Huggins will envy. But who should be comfortable if not he who resigns the blandishments of the dormitory for science's sake?

Upon the night of our visit, the atmosphere, although very clear, was a bad one for astronomical observing. An east wind was blowing, and, as usual under such circumstances, the air was so unsteady that the delicate tests of a telescope's powers—the visual separation of close double stars—could not be resorted to. We saw enough, however, to give us a favourable opinion of the telescope's optical excellence, and we doubt not that it will do a great deal towards wresting from the makers of Munich the palm which they have held for years, on account of the superiority of their object-glasses.

To add to the completeness of the instrument as a whole, it has been furnished with a speculum of 18-inches aperture, forming a reflecting telescope of the Cassegrain form, which can at pleasure be mounted in the refractor tube. The reflector may come into use when it is desired to make certain observations, such as those of the amount of heat radiated from the moon, or from stars which would be affected detrimentally by the passage of the rays from the moon or star, through a lens-glass having the property of intercepting feeble rays of heat.

It would be premature to speak of the results to be anticipated from this instrument. Suffice it to say that Dr. Huggins proposes to pursue systematically and vigorously his spectroscopic researches, upon the stars and nebulæ; and, if ends grow with means, we may expect grand results indeed.

AURORA BOREALIS.

On Sunday, April 9, another magnificent display of aurora took place. Its arc, W.N.W. to N.E., was much lower than in the former displays; but the intensity of the crimson light was far greater. Crossing this light and extending to the constellation of the Great Bear, were beautiful streamers of a fine green colour: these did not form so distinct an umbrella-shaped corona as culminated above Cygnus last year, but the lines were much more distinct and more highly coloured. We watched it from 10·30 to 12·15: at about 11·30 the crimson colour disappeared, and a flood of white light continued to shoot out, at times not unlike a gigantic comet. Soon after 12, it went off. It is not unworthy of notice that the direction of the aurora was identical with that of a semi-transparent line of light clouds. The intensity of the red may be gathered from the fact that all but the largest stars were from time to time obscured. Procyon was distinctly coloured by it. Jupiter alone stood out, with his pure silver light, and a very lovely object he was. By the following extracts it will be seen that at Leeds and other places the red light continued longer than in London:—

Times, April 11.

At 9 p.m. the north horizon appeared preternaturally luminous, and some faint streamers were sent up from an arc that existed between two dark homogeneous cloud modifications. This incipient phenomenon lasted about half an hour. At 9·30, the whole north was illumined by a bright white light. At 10, the western portion became luminous, and sent up long lines of streamers of surpassing beauty. Some were of dazzling whiteness, and interspersed with them were others of rose-pink, that were projected beyond and below the zenith, into the opposite south-eastern horizon, where they joined an expanded body of lurid carmine.

These appearances fluctuated till midnight, when the dark cloud in the north completely obscured the whole sea horizon, and its edges were fringed with radiant streamers.

At 12·30, or half an hour after midnight, a culmination of surpassing beauty occurred. Long streams of yellow, black carmine, light red, and emerald hues were projected towards the plane of the magnetic meridian, where they coalesced and formed a corona.

At 1 a.m., a blood-red radiance still existed in the N.E., and an arc almost due N. sent up faint parti-coloured radiating streamers to the zenith. Small detached rugged masses of what appeared to be pure cirrostratus, drifted over from W. to E.

Throughout the preceding day atmospheric electricity had been at times abnormally developed, and the dip of the magnetic needle was persistent for hours.

With regard to the origin of the varying tints of these beautiful phenomena, it should be borne in mind that the aurora is probably due to electrical discharges, between the positive electricity of the atmosphere and the negative electricity of the terrestrial globe. The electricities themselves are separated by the action of the sun on equatorial regions.

As in the case of lightning, the different hues of the aurora are produced (probably) by the varying altitudes. In the lower regions the light is white, but in the higher regions, where the air is more rarified, it takes a violet tint, as the spark of the electrical machine varies in an attenuated medium or a grosser atmosphere.

The winds are now cold and ungenial. Yesterday an icy stratum existed in the higher regions, as shown by the production of a solar halo.

Vegetation, nevertheless, steadily progresses, and has suffered little comparative injury, owing to the protracted drought. Scarcely a drop of rain has fallen since the 28th of March.

I am, Sir, your obedient servant,

Valley of the Clwyd: April 10. R. H. ALLNAT.

From the *Standard.*

Sir,—The Northern Lights were distinctly visible here last night, at 10·30, the arc extending from W.N.W. to N.E., radiating from the N.N.W. I also observed through the luminous vapour, several stars shoot due north. Apologising for intruding on your valuable space,

I am, &c.,

St. Stephen's, Twickenham: April 10. E. B.

Sir,—A very beautiful Aurora Borealis was seen here last night. It appeared in the western heavens, the radius was of great extent, with much of that characteristic fine red hue in it. The whole display lasted from half-past ten till a few minutes after eleven, and was of a very fine description.

I remain, &c.,

Leyton, Essex: April 10. OBSERVER.

Sir,—About twenty minutes past ten last night, I observed it was very light, and on looking out of doors I found there was a magnificent aurora display. The northern horizon was nearly as bright as day, and on watching it, it got dark, and rays of bright and red colour shot up to the zenith from N.E. to N.W., varying in brightness, the finest being about a quarter to eleven, when it gradually faded, till about ten minutes past, when I went in.

Yours, &c.,

Round Oak, Greenham, Newbury: April 10. J. WARD.

EDINBURGH.—The temperature for some days past has been variable, genial mildness alternating with cold easterly winds. Sunday morning was cloudy, with east wind and a sprinkling of rain. In the afternoon the sun broke through, but the atmosphere continued cold. For two or three hours in the evening the northern sky was lighted up with a display of Aurora Borealis. The phenomenon began to manifest itself shortly after eight o'clock, in the shape of pale green and rose-tinted rays streaming up towards the zenith, from behind a bank of clouds in the north-east. After a time the rose tints disappeared, but the pale-green rays diffused themselves over the northern sky, converging from all points of the horizon to the zenith. When the phenomenon reached its fullest development, rather more than one half of the sky was covered with flickering streamers.—*Scotsman.*

LEEDS.—A remarkably grand display of the Aurora Borealis was visible at Leeds on Sunday night. The extent of space over which the coruscations played was much greater than is usually the case, whilst the light was so vivid, and its tints were so quickly changed, as to produce a spectacle truly gorgeous. About twelve o'clock, apparently from a mass of black cloud resting just above the northern horizon, there shot forth innumerable streaks of light which reached to the zenith. The colour of these streaks was a pale green, with one exception—a broad band of light of a dark purple hue lying towards the east. Whilst the lighter coruscations remained stationary for some time, or varied but little, the purple stream flickered, died away, then reappeared every moment, changing its position and its colour from dark purple to a brilliant red. Half an hour later the beauty and grandeur of the phenomenon attained their highest point. The appearance of the heavens at this moment may be best conceived by imagining a vast number of broad streaks of light, varied in colour with all the hues of the rainbow, converging at a point in the northern horizon, and spreading out, fan-like, to the zenith, and there covering an arc of a circle from 120 to 130 degrees in extent. This lasted but a few moments, when the scene again changed. Later still the north-western portion of the sky presented an appearance similar to that witnessed in the dawn of a bright summer's morning, when the sun first begins to fleck the eastern heavens. Shortly afterwards masses of black clouds overspread the sky, and prevented further observation.

Mr. T. H. Waller, of York, writes in *Nature*: "On first observing the green parts with a spectroscope of one bisulphide prism, the only line distinctly visible was the green one; but by watching and opening the slit there came into view two bands at the more refrangible end, more sharply defined at the more refrangible side than at the other; and there also seemed to be a considerable continuous spectrum from the green lines nearly to the least refrangible of the two bands. In the red parts the red line was most brilliant, quite equal in intensity to the green one, and then even in the green light it was distinguishable with care and long watching."

THE *Messenger of Mathematics*.—We notice that a new series of this publication will be commenced on the first of this month, and a number will appear once a month as nearly as possible, so that twelve sheets may be completed within the year. The subscription is to be 8*s*. 6*d*. per annum, paid in advance; single numbers, 1*s*. Papers are promised by Professor Cayley, Chief Justice Cockle, Mr. Routh, Mr. Esson, and others. It will be published by Messrs. Macmillan & Co., London; and by Messrs. Metcalf & Sons, Cambridge.

We have received Vol. V. of *Symon's Monthly Meteorological Magazine*, which contains much interesting and important information; also the "British Rainfall of 1870," by the same author. To show the pains taken with experiments on this subject, we may mention that at Hawsker, near Whitby, there are no less than twenty-seven various gauges. The observations have been made during the year at about 1,500 different stations in England and Ireland.

Nature learns that the volume containing the various observations of the recent total eclipse will be edited by the Astronomer Royal.

The Savilian Professor of Astronomy at Oxford (the Rev. C. Pritchard, M.A.), who went out with the Eclipse Expedition, will early this term give the scientific world the benefit of his researches in the form of a lecture on the recent solar eclipse.

The Vice-Chancellor of Cambridge has appointed J. Norman Lockyer, Esq., F.R.S., to the office of Sir Robert Rede's Lecturer for the ensuing year. Mr. Lockyer will deliver a lecture in the Easter term.

Notices of Observations.—Allow me to make a suggestion which would I think, if carried out, much improve the value of the correspondence in the *Register*. It is a very simple one—that in *all* accounts of observations, the aperture and power used should be stated (*e.g.*, "6 in. O. G. 120," or "9 in. spec. 180"), and if on stars or planets, the proximity or absence of the Moon. This also would apply to the notes of the Observing Astronomical Society. That the proximity of the Moon affects the bringing out of details on the planets is well known, and I was much struck with it myself when observing Mars some years ago. ("Recreative Science," ii. 212.)

F. W. LEVANDER.

[We have before this asked our correspondents, in giving us accounts of their observations, to state in all cases the aperture, focal length, and power employed.—Ed.]

Mars.—The thanks of your readers are due to "M." for his tables of the position of the disk of Mars; but it would be desirable to know what is his standard in measuring the longitude. He seems to measure it from nearly the same meridian that R. A. Proctor uses, but goes round Mars the opposite way, his long. 30° being about the same as Proctor's 330°, and so on. An agreement should be come to as to which is the right way; to me, "M."'s seems the most natural.

Sunderland: April 13, 1871. T. W. B.

OBSERVATIONS FOR MAY, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich midnight	60°N.	0°	60°S.
	SUNRISE.		
	°	°	°
1871. May 1	−53·8	−55·9	−58·1
2	66·0	68·1	70·2
3	−78·2	−80·3	−82·4
	SUNSET.		
4	+85·5	+87·5	+89·7
5	73·4	75·4	77·4
6	61·2	63·2	65·1
7	49·1	51·0	52·9
8	36·9	38·8	40·7
9	24·8	26·6	28·5
10	12·6	14·4	16·2
11	+0·4	+2·2	+4·0
12	−11·8	−10·0	−8·3
13	24·0	22·2	20·5
14	36·1	34·5	32·8
15	48·3	46·7	45·1
16	60·5	58·9	57·3
17	−72·7	−71·2	−69·6

SUNRISE.

19	... +85·8	... +84·3	... +82·8
20	... 73·5	... 72·1	... 70·6
21	... 61·3	... 59·8	... 58·4
22	... 49·0	... 47·6	... 46·2
23	... 36·7	... 35·4	... 34·0
24	... 24·4	... 23·1	... 21·8
25	... +12·2	... +10·9	... +9·7
26	... —0·1	... —1·3	... —2·5
27	... 12·4	... 13·5	... 14·7
28	... 24·6	... 25·7	... 26·8
29	... 36·8	... 37·9	... 39·0
30	... 49·1	... 50·1	... 51·1
31	... —61·3	... —62·3	... —63·3

MARS.

Areographic longitude and latitude of apparent centre of disk, angle of position of axis, diameter, and amount and angle of position of greatest defect of illumination.

1871.	Longitude. 8h.	10h.	12h.	Lat. 12h.	Axis.	Diam.	Def. of Illum.	
May 1 ...	346°	16°	45°	... 26·9°N.	... 22·9°	... 11·83″	... 0·76″	115°
2 ...	337	7	36	... 27·0	... 22·9	... 11·74	... 0·78	115
3 ...	328	357	27	... 27·0	... 22·9	... 11·65	... 0·79	115
4 ...	319	348	17	... 27·1	... 23·0	... 11·56	... 0·81	114
5 ...	310	339	8	... 27·1	... 23·0	... 11·47	... 0·83	114
6 ...	301	330	359	... 27·1	... 23·0	... 11·38	... 0·84	114
7 ...	291	321	350	... 27·2	... 23·1	... 11·29	... 0·86	114
8 ...	282	311	341	... 27·2	... 23·1	... 11·20	... 0·87	114
9 ...	273	302	331	... 27·3	... 23·1	... 11·11	... 0·88	114
10 ...	264	293	322	... 27·3	... 23·2	... 11·03	... 0·89	114
11 ...	254	284	313	... 27·3	... 23·2	... 10·94	... 0·90	114
12 ...	245	274	304	... 27·4N.	... 23·3	... 10·86	... 0·92	114

VARIABLE STARS.

Approximate time of minima and maxima of some variable stars, which, according to the statements made by Schoenfeld and Winnecke, may be expected in May.

1871		G. M. T. h. m.	Star		A. R. h. m. s.		Decl. ° ′	
May 2	...		S Vulpeculæ	min.	19 42 27	+	26 55·7	
4	...	9 4	δ Libræ	„				
7	...		S Delphini	„	20 36 24	+	16 34·2	
9	...	9 4	S Cancri	„	8 35 39	+	19 33·2	
—	...		R Boötes	„	14 30 48	+	27 22·1	
11	...	8 8	δ Libræ	„				
18	...		R Camelopardali	max.	14 28 54	+	84 29·2	7m.
—	...	8 4	δ Libræ	min.				
19	...		R Capricorni	max.	20 3 10	—	14 41·6	9m.
28	...	8 7	S Cancri	min.	8 35 39	+	19 33·2	

Place of star 1855.

NEW COMET.

A new comet was discovered on April 7, by M. Winnecke, at Karlsruhe.

ELEMENTS.

Epoch of Perihelion passage = 1871, June 11·23.

		°	′
Longitude of Perihelion	=	138	51
Longitude of ascending Node	=	278	19
Inclination of Orbit	=	88	5
Log. Perihelion Distance	=	9·8342	

Heliocentric Motion :—
Calculator :—Pechule.

EPHEMERIS.—For Berlin mean noon.

1871.		R. A.		Decl.
May 1	...	4h. 4·1m.	...	+40° 20′
2	...	4 7·4	...	39 40
3	...	4 10·6	...	39 0
4	...	4 13·8	...	38 19
5	...	4 17·0	...	37 37
6	...	4 20·1	...	36 55
7	...	4 23·1	...	36 13
8	...	4 26·1	...	35 30
9	...	4 29·1	...	34 47
10	...	4 32·0	...	34 4
11	...	4 34·8	...	33 20
12	...	4 37·6	...	32 36
13	...	4 40·4	...	31 51
14	...	4 43·1	...	31 6
15	...	4 45·8	...	30 21
16	...	4 48·5	...	29 35
17	...	4 51·1	...	28 48
18	...	4 53·7	...	28 2
19	...	4 56·2	...	27 15
20	...	4 58·7	...	26 27
21	...	5 1·2	...	25 39
22	...	5 3·6	...	24 51
23	...	5 6·0	...	24 2
24	...	5 8·4	...	23 13
25	...	5 10·7	...	22 23
26	...	5 13·0	...	21 33
27	...	5 15·3	...	20 43
28	...	5 17·6	...	19 52
29	...	5 19·8	...	19 1

The comet is slowly approaching the earth, and has an insignificant tail.

G. F. CHAMBERS.

Windyhills Observatory, Bickley:
April 21, 1871.

NOTICES TO CORRESPONDENTS.

Several communications are deferred from want of space.

BOOKS RECEIVED. "Romance of Motion," by Alec Lee (will be noticed in our next). Report of Observing Astronomical Society (being a reprint of Papers which have appeared in the *Astronomical Register*).

Erratum in pp. 96 & 97. For *Clairvaut*, read *Clairaut*.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1870.

Browning, J.
Clarke, J. S.

To March, 1871.

Metcalfe, Rev. R. W.

To June, 1871.

Cooke, T.
Cotsworth, H.
Elliott, R.
Hemming, Rev. B. F.
Jackson-Gwilt, Mrs.
Lancaster, J. L.
Lancaster. W. L.
Lawton, W.
Lee, A.
Lee, G.
Wright, W. H.
Woodman, T. C.

To Dec. 1871.

Abbot, F.
Bates, Rev. J. C.
Daw, F.
Horner, Rev. J.
Terry, J.

To Dec. 1872.

Longmaid, W. L.

April 28, 1871. Subscriptions after this date in our next.

THE PLANETS FOR MAY.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′	″	h. m.
Mercury ...	1st	3 40 37	+22 7½	9″·6	1 4·5
	15th	3 28 16	18 7½	12″·0	23 51·2
		3 26 11	17 42½		
Venus ...	1st	4 52 59	+24 3	13″·0	2 16·7
	15th	6 5 37	25 25	14″·0	2 34·1
Mars ...	1st	11 22 54	+6 4½	14″·0	8 45·5
	15th	11 27 2	5 2	12″·6	7 54·6
Saturn ...	1st	18 42 13	−22 17½	15″·8	16 3·7
	15th	18 40 20	22 19½	16″·2	15 6·8
Uranus ...	1st	7 39 34	+22 0	4″·0	5 2·8
	13th	7 41 12	21 56½	4″·0	4 17·3

Mercury may be observed as a morning star during the latter part of the month, rising about half an hour before the sun. The planet passes the meridian twice on the 14th of this month, at 3·2min. past noon, and again at 23h. 57·2min., or about 3 minutes before noon, on the 15th.

Venus is situated as well as possible for observation this month.

Mars is visible throughout the night.

Jupiter is still visible for some time after sunset: about four hours at the beginning of the month, the interval decreasing to an hour and a half by the 31st.

Saturn is a morning star.

Uranus is fairly situated for observation.

ASTRONOMICAL OCCURRENCES FOR MAY, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
						Moon.
Mon	1		Sidereal Time at Mean Noon, 2h. 35m. 53·56	2nd. Sh. E.	9 10	9 26·5
Tues	2		Saturn's Ring: Major Axis=39″·56 Minor Axis=16″·83			10 16·8
Wed	3	13 27 14 25 14 7 14 51	Occult. of 94 Virginis (6) Reappearance of ditto Occult. of 95 Virginis (6) Reappearance of ditto	3rd. Oc. R. „ Ec. D.	8 37 9 26 56·4	11 8·9
Thur	4	10 59·9	○ Full Moon Meridian Passage of the Sun, 3m. 21·61s. before Mean Noon			12 3·6
						Mars
Fri	5	17 4	Occultation of ν Scorpii (4)			8 30·2
Sat	6			1st Tr. I. „ Sh. I.	9 2 9 54	8 26·4
Sun	7			1st Ec. R.	9 26 52·3	8 22·7
Mon	8	3 59	Conjunction of the Moon and Saturn, 1° 31′ N.	2nd. Sh. I. „ Tr. E.	9 2 10 7	8 19·1
Tues	9					8 15·5
Wed	10			3rd Oc. D.	10 8	8 11·9
Thur	11	2 23·2 23 0	☾ Moon's Last Quarter Conjunction of Jupiter and Venus, 1° 58′ N.			8 8·4
Fri	12					8 4·9
Sat	13					8 1·4
Sun	14			1st Oc. D.	8 23	7 58.0
Mon	15	1 0	Inferior Conjunction of Mercury Illuminated portion of disk of Venus=0·765 „ of Mars=0·913	1st. Tr. E. „ Sh. E. 2nd. Tr. I.	7 50 8 34 10 13	7 54·6

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Mars. —
Tues	16		Sidereal Time at Mean Noon, 3h. 35m. 1·89			7 51·3
Wed	17		Meridian Passage of the Sun, 3m. 52·22s. before Mean Noon	2nd Ec. R.	8 40 31·0	7 48·0
Thur	18	22 45·0 10 23	● New Moon Conjunction of Moon and Mercury, 1° 38′ N.			7 44·7
Fri	19	17 27	Conjunction of Jupiter and ι Geminorum, 0° 6′ S.			7 41·5
Sat	20					7 38·3
Sun	21	0 5 15 0	Conjunction of Venus and ε Geminorum, 0° 3′ S. Conjunction of Moon and Jupiter, 0° 3′ N.	3rd Sh. E.	10 17	7 35·1
Mon	22	12 10	Conjunction of Moon and Venus, 1° 19′ N. Saturn's Ring: Major Axis=40″·62 Minor Axis=17″·38	1st Sh. I. „ Tr. E.	8 12 9 51	7 32·0
Tues	23	15 22	Conjunction of Moon and Uranus, 1°31′ S.			7 28.9
Wed	24					7 25·9
Thur	25					7 22·8
Fri	26			4th Tr. I.	9 3	Moon. — 5 41.4
Sat	27	1 2·3	☽ Moon's First Quarter			6 29·3
Sun	28	5 49	Conjunction of Moon and Mars, 4°39′ S.	3rd Tr. I.	9 9	7 16·9
Mon	29			1st Tr. I.	9 35	8 5·0
Tues	30	9 53 10 42	Occultation of 80 Virginis (6) Reappearance of ditto	1st Ec. R.	9 41 23·6	8 54·5
Wed	31					9 46·7

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN MAY, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight. ° ′	Objects to be observed.
1	... 40 46 ...	Anaximenes. Herschel II. (*a*). Sunrise on region N. of Herodotus. (*b*)
2	... 27 19 ...	Aristarchus, character of its floor.
3	... 13 30 ...	Segner, Rosse (*c*), Phocylides.
4	... 0 35 ...	Maginus, full moon aspect of interior.
21	... 152 21 ...	Hahn, Berosus, Condorcet (*d*).
22	... 141 29 ...	Wrottesley (*e*), Snellius, Stevinus.
23	... 130 32 ...	Taruntius, objects in interior.
24	... 119 25 ...	Posidonius, and craters north of it (*f*).
25	... 108 5 ...	Ridges on the Mare Serenitatis (*g*).
26	... 96 28 ...	Cassini, Piazzi Smyth (*h*), Renuker (*i*).
27	... 84 28 ...	Abenezra, Azophi, Agrippa Godin.
28	... 72 4 ...	Short, Newton, Cabeus.
29	... 59 12 ...	Sinus Iridum (*k*), Delisle, Diophantus.
30	... 45 52 .	Bianchini, Sharp, Mairan.
31	... 32 8 ...	Campanus, Mercator, Capuanus.

For additional objects consult the lists for January and March. A comparison of the positions of the terminator, March and May, will be a good guide in selecting objects. On the 24th of March, the terminator had not arrived at Taruntius and Messier; these craters may be looked for on the 22nd.

(*a*) The finest of a fine group of formations near the N.E. limb, imperfectly represented by B. and M. See Reports of the British Association, 1862: Transaction of Sections, pp. 10—12; also *Monthly Notices R.A.S.*, vol. xxiv. p. 20.
(*b*) Well observed on March 3, 1871.
(*c*) See *Monthly Notices R.A.S.*, vol. xxiv. p. 20.
(*d*) There are two conspicuous craters, S. and S.S.W. of Condorcet, well seen on March 23. They are not in Webb.
(*e*) See *Monthly Notices R.A.S.*, vol. xxiv. p. 20.
(*f*) See *English Mechanic*, No. 308, Feb. 17, p. 516.
(*g*) With longitude of terminator at 60° N. latitude, varying from 20° to 12° W. and 24° to 12° in one equator, the ridges on the Mare Serenitatis may be studied to advantage.
(*h*) See *Monthly Notices R.A.S.*, vol. xxiv. p. 20. This crater with a mountain near it. named Piton, are situated between Plato and Archimedes.
(*i*) Named by the late Dr. Lee to commemorate the astronomical labours of the Director of the Observatory at Hamburg.
(*k*) On September 20, 1870, M. Gandibert discovered four ridges on the Sinus Iridum; they were seen with an aperture of 2¾ inches, on the 31st of January, 1871, when at least four additional ridges were detected with this small aperture.

Errata in former lists.

Jan. 24. For *Vandelinus*, read *Vendelinus*.
Feb. 27. For *Parrol*, read *Parrot*.
April 3. For *Sersalis*, read *Sirsalis*.
„ 22. For *Seminus*, read *Geminus*.
„ 24. For *Lithrow*, read *Littrow*.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. Gorton, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 102. JUNE. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Seventh Meeting, May 12th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The President, on taking the chair, said that probably every one in the room was aware of the loss they had sustained by the death of their esteemed colleague, Sir John Herschel, which had struck all men of science like the loss of a personal friend, while to those who had the pleasure of knowing him intimately the deprivation could hardly be over-estimated. He (the chairman) would not now pretend to offer any eulogium of his departed friend—that would be done hereafter by abler men; but the eloquent writings, the great scientific knowledge, the kindness and urbanity of character, and other fine qualities of Sir John, were known to all. The Council had at once resolved to offer an expression of their warmest sympathy to Lady Herschel on her irreparable loss. He would read the resolution which he was charged to transmit to the widow; and if the meeting desired, he should be happy to add to it a statement that the whole Society concurred in the sentiments of the Council. Truly might it be said of their late Fellow, "We ne'er shall look upon his like again."

The address was as follows:—

"The Council of the Royal Astronomical Society have read with the deepest concern the announcement of the death of their eminent and much revered Fellow and former President, Sir John

Herschel; and although they feel reluctant to intrude on the privacy of Lady Herschel at this time of her poignant sorrow, they cannot refrain from expressing their heartfelt sympathy in her grief, and they beg permission to assure her how fully they have always appreciated the high attainments, the great genius, and the noble qualities, which characterised Sir John Herschel as a philosopher and as a man. In their opinion, no man in modern times has done so much to promote the advancement of science, in its most comprehensive sense, or to maintain for it an appreciation of its dignity."

The Fellows present at the meeting unanimously requested that their concurrence might be notified as suggested.

The Astronomer Royal said, that as probably the oldest friend of Sir John Herschel present, his intimacy extending over nearly fifty years, he was desirous of remarking that although the Council had in their address expressed all that was in their power, it would fall far short of what Sir John's friends would feel. For himself he could say, that of all men in the world he should have chosen Sir John as the representative of truth and kindness.

The minutes of the last meeting were read and confirmed.

Twenty-six presents were announced, and the thanks of the Society given to the respective donors.

J. H. Bluum, Esq.,
Clarence E. Trotter, Esq.,
Reginald Bushell, Esq., and
H. Mann, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

On η Argus and its surrounding Nebula: by Mr. Abbott.

On the Occultation of Uranus on March 2, 1871: by Mr. Maguire.

Capt. Noble having complained that he had been misled by trusting to the Nautical Almanac, as upon going to observe the occultation two minutes before the predicted time, he found the planet had already disappeared; the author recalculated the times of the phenomena, and found that the particulars given in the Nautical Almanac, which does not attend to fractions of a minute, were correct as to the disappearance, although there is an error in the prediction for reappearance. If Capt. Noble were at Maresfield, the calculated time was correct. Was there an error made in the moon's place or the planets?

Capt. Noble said there could be no mistake as to the fact that the planet disappeared before the time mentioned, as his clock was checked by a 2¾-inch Simms Transit, which gave him time to the tenth of a second.

Mr. Lancaster had also been disappointed by relying on the Nautical Almanac. He felt sure his time was not a quarter of a minute out.

The Astronomer Royal said, there appeared to be some little misapprehension between what the Nautical Almanac does on the one side, and what observers expect on the other. The Nautical Almanac gives the results attained by computations from the existing tables. The tables of the Moon are very correct, but the tables of Uranus are considerably in error. If the Greenwich observations be referred to, it will be seen that the results of observation and calculation show great discrepancies. There is a great want of fresh tables, but it requires much leisure and some talent in the computer, and perhaps some pecuniary aid.

The President inquired when the last occultation of Uranus took place?

The Astronomer Royal did not remember. Certainly not lately, but Uranus had been much observed on the meridian.

The President: If the last occultation is recorded, it should have warned observers in March to be five minutes early.

Capt. Noble: The conduct of the authorities seems to me comparable to that of a local board, who having to put up a direction-post at four cross roads employ a carpenter who cannot spell. I have repeatedly, in this room, called attention to the error of eleven minutes, or more, in the predictions as to Jupiter's Satellites, and yet they persist in printing tables from year to year, in our Nautical Ephemeris, which are admitted to be grossly wrong.

The President: I believe the calculations are made to be used with a telescope of 46-inches focal length; but with the larger telescopes now in use the phenomena are seen at different times.

Capt. Noble: Sufficient observations have accumulated for the correction of the tables, and if the Government will not pay for the computation of fresh ones, they ought at least to give warning their book is not to be relied on.

The President: Observers should certainly be prepared for possible errors.

Mr. Dunkin: The errors in the eclipses of the 1st and 2nd satellites are very small indeed; with the 3rd they are larger, and with the 4th very much so; but it should be remembered those of the 4th are very rare, and that very little improvement could be effected as to that satellite.

The Astronomer Royal corroborated Mr. Dunkin on this point, and having sent for a volume of Greenwich Observations, showed that in 1867 the errors of R. A. for Uranus were 15 or 16 seconds *of time;* while the error of N. P. D. was very small.

There was nothing comparable to this error in any other planet; even in the case of Neptune it was only one or two seconds. Tables could not be corrected by bits, but must be done throughout at once.

The President: Would this error in the tables account for the two minutes by which the occultation was lost?

The Astronomer Royal: Yes, far more. I see that the errors of Jupiter's fourth satellite are 5m. 11s., 3m. 43s., 3m. 11s., and so on; while those of the second satellite are only 19s. to 38s. The eclipses of the fourth satellite are cut off during a large portion of time, and are therefore rarely caught. If tables of satellites or planets are to be altered, it must be done at one operation, and completely, from beginning to end; and Jupiter's satellites are so mixed up together as to render this a most complicated matter, as account must be taken of them all at the same time, which makes it one of the most formidable practical operations in astronomy.

Mr. Dunkin: The occultation of Uranus took place six minutes before the time mentioned in the Nautical Almanac. There might as well be a warning note in future years.*

Note on the Reappearance of Encke's Comet in 1871: by Mr. Hind.

The places of this comet will be as favourable as possible for observation in the northern hemisphere at the coming apparition. No doubt very complete ephemerides will be issued from Berlin in good time, but a few early places may be useful, which have been calculated on the assumption that Forster's elements are correct.

Perihelion passage, December 29, 1871.

oh. G.M.T.			R. A. °	′		Dec. °	′
August	21	...	−31	11	...	+24	4
	31	...	31	48	...	26	0
Sept.	10	...	31	32	...	28	8
	20	...	29	57	...	30	32
	30	...	26	18	...	33	13
Oct.	10	...	19	19	...	+30	4

On the Total Solar Eclipse of 1878: by Mr. Hind.

The particulars necessary for observing at stations in the United States, at Denver, Colorado, and in the Havannah were given in this paper.

The Astronomer Royal mentioned that Mr. Hind had communicated to him the fact that the next total solar eclipse visible in the British Isles would be in the year 1999.

* The Editor of the *Astronomical Register* must add his testimony to the necessity of this warning; three or four minutes before the given time he looked for the occultation of Uranus, but in vain.

On De Vico's Comet of short Period: by Mr. Hind.

This comet was discovered in 1844, but was not seen when expected again in 1850, nor was it detected in 1855, 1860, or 1866. An elaborate investigation by Prof. Brunnow seems to show there must have been some inaccuracy in observing the daily motion, and that for its rediscovery we must look to the labours of those astronomers who sweep for telescopic comets. The same observation applies to Peters' Comet.

Elements and Ephemeris of Comet I., 1871: by Mr. Hind.

These were calculated from the places given by Winnecke, the discoverer, on April 7, and two subsequent observations at Mr. Bishop's Observatory.

On the first Comet of 1867: by Mr. Hind.

This comet was discovered by Stephan at Marseilles, in January, 1867. Its period is 33·62 years. The author remarks on the near approach of its orbit to that of Uranus, and the singular commensurability between the bodies.

	Years.
5 × sidereal period of Comet =	168·120
2 × sidereal period of Uranus =	168·052

Affording a parallel to the well known 5 to 2 relation in the great inequality of Jupiter and Saturn.

If the elements used, which are those calculated by Mr. Searle, of Harvard College, be correct, the comet did not suffer any extraordinary perturbation in 1817, but in 1649 the distance may have been much less. The elements correspond well with the observations.

Ephemeris of the Periodical Comet of Tuttle for its approaching reappearance: by Mr. Hind.

The perihelion is calculated to occur on November 30, 1871.

The places from September 1 to October 19 range between—

R. A.							
°	′	″		°	′	″
100	13	2	and	+ 62	22	7
141	40			+ 37	20	8

The track is very favourable for observations.

Observations of Mars, with Drawings: by Mr. Joynson.

The paper was accompanied by a large number of drawings of the planet, made during the last opposition, as well as a repetition of some previously forwarded, made in 1862, 1864, and 1867. The first set were made with a refractor $3\frac{1}{2}$-inches aperture, the others with a 6-inch refractor. The drawings were made at intervals of 37 minutes, so that the face of the planet was completely changed in every 10 drawings, or about 6 hours. About one-fourth of the planet was seen at a time, or a whole hemisphere in 20 drawings. The north Polar snow was of less extent than at the preceding opposition, and more like the southern snow in 1862. The general colour was yellowish or brownish, but near the poles this was difficult to observe, as the colour varied from night to night. The central band and wine-glass shaped channel are clearly permanent markings. The drawings are arranged with corresponding phases, one above the other, for easy comparison.

Capt. Noble thought the drawings very inconveniently arranged, and the north Polar snow much too small. He had made some coloured drawings of Mars, and wished to ask if any one had noticed during the last few nights that the gibbous shape of Mars made the Polar snow look quite pointed?

Mr. Browning had been drawing Mars, and thought the snow in Mr. Joynson's sketches about one-fifth of the proper size. He had distinctly seen the spot assume a sugar-loaf shape.

Une Nouvelle Spectroscopique: by P. Secchi.

Dr. Huggins translated this paper, which stated that the author had devised a new spectroscopic combination, by which the spots and solar prominences, with their spectral lines, could be seen in the same visual field. This was done in two ways. In the first, a large prism was placed in front of the object-glass, which caused a coloured image to fall on the slit of the ordinary spectroscope. The second plan was to place a prism of great dispersive power before the slit of the spectroscope. By both plans an image of the object in rays of one colour could be obtained, in which the spots and limb of te sun were very well defined, and the phenomena were seen as well as with coloured glasses, and the chromosphere and protuberances exhibit themselves as bright lines extending more or less from the limb. This mode gives the prominences only as lines, as in Jansen's method, but it is possible to map them by the height of these lines. If the slit be opened more, the shape is seen, but the definition lost. When closed sufficiently the spots and prominences are seen by the lines. If we get the line C brilliant or less black, it shows hydrogen. Calcium and iron are also seen by their lines.

Mr. Browning said it was desirable to explain what had been done, as otherwise the paper might not be understood. Dr. Huggins had been experimenting in the same direction. The plan was to take a direct vision prism of great dispersive power. If we looked through this at a tree or a house, we got an image of it of one colour. The proposition is to magnify this image by a telescope. With the sun's image thus obtained, the lines C and F of hydrogen would be seen; and the lines of the whole of the sun's limb, and prominences in succession.

Dr. Huggins: Father Secchi seems to use a direct vision prism before the slit, or before the object glass, to get light of one colour, and get rid of all false light. The plan I thought of is somewhat different. It was to place the slit some distance within the cone of rays from the object-glass, before they reached the focus. The image of the sun was then formed behind the lens of the collimator, and among the prisms. If an eye-piece be used with the small telescope, an image of the slit is seen, and the ordinary solar spectrum. Then I brought the C line to the centre of the field, and removed the eye-piece of the telescope. A slit being placed there, and the eye to the narrow opening of the slit, light of the refrangibility of C, and no other, could enter the eye. As the solar image was formed about as far in the front of the object-glass of the little telescope as the eye behind it, the sun was seen, not a spectrum, of that particular refrangibility, and I hoped to see the prominences surrounding it. Though I saw the limb distinctly defined, I failed to see the prominences on account of the diffraction bands produced by the edges of the slit, which produces a series of images that enfeeble the light too much. It might probably work with a more powerful spectroscope and a wider slit. It is essentially different in principle from Secchi's plan; and by this method any object can be seen with monochromatic light.

Note on the Change in Colour of the Equatorial Belt of Jupiter: by Mr. Browning.

The last number of the *Astronomical Register* contains a report of a discussion on this subject, at the monthly meeting of the R. A. Society, in which, with the exception of Messrs. Ranyard and Penrose, the whole of the speakers considered that no change had taken place in the colour of the planet.

It was suggested that the reason the colour on the equatorial belt is seen by many observers, while it was not seen in previous years, is to be accounted for by the fact that within the last few years many observers have become possessed of silvered glass reflectors of large aperture.

With all deference to such admirable observers, I would beg to point out that such an explanation will not hold good in my own case.

Five years ago I began making careful coloured drawings of Jupiter with a reflector of 10¼-inches aperture. Several years ago I drew attention to the fact that colour is best seen with small apertures, unless high powers be used. I worked with powers from 350 to 500 whenever the air would permit me. Although at that time I saw easily the coppery grey of the dark belts, and the bluish grey of the poles, I could detect no colour on the equatorial belt. Yet for the last two years the tawny colour of the equatorial belt has been more conspicuous than either.

It is true that during the last three years I have had a $12\frac{1}{4}$-inch equatorial reflector, but practically I have seldom indeed used more than 10 inches of aperture.

Several observers have seen the tawny colour of the belt with both refractors and reflectors of only three or four inches aperture.

The exact colour of the equatorial belt may be obtained by allowing a very powerful light to pass through a jet of steam, so that an increase in the luminosity of the body of the planet would completely account for the colour of the belt.

If, as I suspect, the colour appears periodically, we shall have to wait four or five years before we can decide this matter. Colour observations are, I am aware, liable to many sources of error; but I cannot think that any person accustomed to the use of colours could mistake yellow ochre for white, under the peculiar circumstances of this case, for during the whole of the time the change in colour has been going on upon the equatorial belts, belts to the N. and S. of it have remained almost colourless.

On the Use of Compound Prisms: by Mr. Browning.

On a Double Automatic Spectroscope: by Mr. Proctor.

The author states that Mr. Browning having constructed the double battery of prisms in an automatic spectroscope, which he (Mr. P.) had suggested last September, he now proposed a modification, in which simple prisms were to be replaced by Grubb's compound prisms, and sent a diagram of the contrivance. He admitted that this form would present considerable difficulties for the optician and mechanician to surmount, but after what had been accomplished, expected it would soon be done.

Note on η Argus: by Mr. Tebbutt, jun.

This paper was a series of comparisons of the star with others, from 1854 to 1870, during which it had dwindled down in magnitude from 1·10 to 6·25, having for the last three years been invisible to the naked eye. From 1854 to 1863, the author used stars, contained in certain tables in Sir J. Herschel's Cape Observations, and subsequently stars carefully selected and compared by himself. The observations were combined into groups, and the result projected in a curve, which showed a small annual fluctuation in the light of η Argus, above and below the mean magnitude, amounting to about a quarter of a magnitude, and evident during the last three or four years.

Mr. Ranyard read some extracts from the Philosophical Transactions, to show that the change of colour in Jupiter's equatorial belt had been noticed by Sir W. Herschel. Thus in 1790 he described the equatorial zone as of a yellowish cast; but in 1792 as of a brownish grey. He had, therefore, evidently noted a change of colour. In connection with the sun spot curve, it was an interesting fact that the colour was reddish at the maximum and yellow at the minimum. By comparing the twenty-six spots referred to at the last meeting with the sun spot curve, it would be seen the white spots coincided with the maximum, and the black with the minimum.

On a free regulator Clock: by Mr. Kincaid.

Dr. Huggins said that it might be interesting to the meeting to hear some account of his recent observations of the *Spectrum of Uranus.* Having made a drawing of the spectrum, and some of the principal solar lines, he proceeded to state that the planet's spectrum was distinguished by six strong bands due to absorption at the planet. The Fraunhofer lines could not be seen, as when he attempted to close the slit of the instrument sufficiently for this purpose the light was too weak; but with a wide slit six planetary lines were visible. Measures of these had been obtained, from which it appeared that one was coincident with F, one near E, one on each side of D, and one halfway from C to D. None of these were in the position of the earth's atmospheric lines. He tried a direct comparison of hydrogen with the F line, with which it seemed to coincide. Three of the lines were very near the three principal lines of nitrogen, but when nitrogen was compared with the strongest, the latter was a little more refrangible. The other two were very near indeed to nitrogen lines, but not quite coincident, so that they could not be attributed to that gas. Two others were not far from the carbonic acid lines, and were compared with it, but were not coincident. At present, therefore, it must be admitted we do not know the cause of these lines. In 1869, Secchi observed the Spectrum of Uranus, but his account differed materially from the present appearance. He stated that a considerable part of the spectrum was cut out, and that there were two bands, probably some of those seen by the speaker, while the others seen nearly together might look like a gap in the spectrum. Dr. Huggins further stated that the comet now visible had been observed by him, and proved to exhibit the same three bright bands he had observed in the comet of 1868. One was a little more refrangible than *b*. He had measured these bands, and had no doubt they were the same as seen in 1868.

The meeting then adjourned.

The *London Gazette* of the 19th ult. announces that the Order of the Bath has been conferred upon G. B. Airy, the Astronomer Royal; and Admiral Richards, Hydrographer of the Admiralty.

THE LATE SIR JOHN HERSCHEL.

(From the *Times* and other sources.)

We have to record the death of Sir John Frederick William Herschel, F.R.S., &c., the only son of Sir William Herschel, who just 90 years since discovered Uranus, first called Georgium Sidus, and sometimes also Herschel, whose initial H stands for its symbol. His mother was Mary, daughter of Mr. Adee Baldwin; he was born at Slough, Buckinghamshire, on the 7th of March, 1792. He was educated privately, under a Scotch mathematician named Rogers, from whose hands he passed to St. John's College, Cambridge, where he took his Bachelor's Degree in 1813, coming out as Senior Wrangler and first Smith's Prizeman. In the same year he published his first work, *A Collection of Examples of the Application of the Calculus to Finite Differences.* In 1819 he commenced a series of papers in the *Edinburgh Philosophical Journal* on miscellaneous subjects in physical science, and in 1822 communicated to the Royal Society of Edinburgh a paper on the absorption of light by coloured media, which will be found in the *Transactions* of that society. He spent a great part of the years 1821-23, in conjunction with the late Sir James South, in making a number of observations on the distances and positions of numerous stars, a full account of which is to be found in Part III. of the *Philosophical Transactions* for 1824, in which year they reported to the Royal Society the position and apparent distances of 380 double and triple stars obtained by more than 10,000 measurements.

In the summer of 1825, he made a series of observations to determine the dfference of the meridian of the Royal Observatories of Greenwich and Paris, and began to re-examine the numerous nebulæ and clusters of stars which had been discovered by his father. On this work he was employed for eight years, and its results will be found in the above-mentioned work for 1832. The catalogue includes upwards of 2,300 nebulæ, of which 525 were discovered by Sir John himself. It may be added that while engaged upon this work, he also discovered between three and four thousand double stars, which are described in the *Memoirs of the Astronomical Society.* These observations were made with an excellent Newtonian telescope, 20 feet in focal length and 18½ inches aperture; and "having obtained," to use his own words, "a sufficient mastery over the instrument," he conceived the idea of employing it in the southern heavens. To this end, at his own expense, he set up an observatory in 1834, at Table Bay, and continued his observations there till May, 1838. In 1847 he published the results in a volume, entitled *Results of Astronomical Observations made during* 1834-38 *at the Cape of Good Hope; being the Completion of a Telescopic Survey of the Whole Surface of the Visible Heavens, commenced in* 1825, the expense being borne by the Duke of Northumberland.

The main object of his survey of the southern hemisphere was to discover whether the distribution of the stars in the southern hemisphere corresponded with the results of his father's labours, which were prosecuted chiefly on the Galactic circle. The whole number of stars counted in the telescope amounted to 68,948, which were included in 2,299 fields of view. By a computation based on the star gauges in both hemispheres relative to the Milky Way, Sir John found the stars visible in a reflecting telescope, 18 inches aperture, amounted to 5,331,572, and more than this, for that in some parts of the Milky Way the stars were so crowded as to defy all attempts to count them.

Besides his astronomical labours at the Cape, he was always ready to give the colonial authorities his advice and aid on scientific and educational matters. It is to him that the Cape colonists are mainly indebted for the very perfect system of national education and public schools which they now enjoy, and which he was enabled to carry out through the sagacity and liberality of the late Sir George Napier, at that time Governor, and of his Colonial Secretary, Mr. Henry Montagu.

Sir John Herschel's residence at the Cape was productive of benefits not only to astronomy but also to meteorology. While occupied there, he suggested a plan of having meteorological observations made simultaneously at different places—a plan subsequently developed at greater length in his *Instructions for Making and Registering Meteorological Observations at various Stations in South Africa*, published under official military authority in 1844. He had already received from the hands of King William IV. the Hanoverian Guelphic Order of Knighthood, and on his return to England, in 1838, he was received with every possible public honour. During his absence in the southern hemisphere, the Astronomical Society had voted to him their Gold Medal in 1836. Two years later, on the coronation of Queen Victoria, he was created a baronet. In 1839 he was made an honorary D.C.L. of Oxford University, and there was a proposal, which he declined, to elect him to succeed the late Duke of Sussex in the presidential chair of the Royal Society. In 1842 he was elected Lord Rector of Marischal College, Aberdeen. In 1848 he was President of the Royal Astronomical Society, and in the same year the society voted him a testimonial for his work on the southern hemisphere.

In addition to various incidental papers published in the *Transactions* of the Astronomical Society, he gave to the world the *Outlines of Astronomy* (enlarged from the former treatise in *Lardner's Cyclopædia*), which he published in 1849. In the same year he edited a collection of papers by various authors, published by authority, and entitled, *A Manual of Scientific Inquiry, prepared for the Use of Her Majesty's Navy, and adapted for the Use of Travellers in general.* In December, 1850, when the Mastership of the Mint was converted from a ministerial into a permanent office, it was conferred upon Sir John Herschel, and this post was retained by him till 1855, when he resigned it on occount of ill-health, and Professor Graham, the eminent chemist, was appointed his successor.

Sir John Herschel was the author of the articles on "Isoperimetrical Problems" and "Mathematics," in the *Edinburgh Encyclopædia*, and of "Meteorology" and "Physical Geography" in the *Encyclopædia Britannica* (the last two of which have been republished separately), and also of several articles on scientific subjects in the *Edinburgh* and *Quarterly Reviews*, which were collected and published in a separate form in 1857, together with some of his lectures and addresses delivered on public occasions. He besides occasionally contributed to *Good Words* some popular papers on the wonders of the Universe; and some two or three years ago he gave to the world, in the pages of the *Cornhill Magazine*, a poetical version of part of the *Inferno* of Dante. He was also one of the too numerous translators of *Homer*.

From the Catalogue of the Royal Society we learn that he contributed 180 memoirs to the *Scientific Transactions*, and journals devoted to science; two others, in conjunction with Mr. Babbage and the one with Sir James South: he contributed also treatises on "Sound" and "Light," to the *Encyclopædia Metropolitana*.

Sir John Herschel was an honorary or corresponding member of the academies of St. Petersburg, Vienna, Gottingen, Turin, Bologna, Brussels, Naples, Copenhagen, Stockholm, and of almost all other scientific associations in England and America. To his other honours were added that of Chevalier of the Prussian Order of Merit, founded by Frederick the Great and given at the recommendation of the Academy of Sciences at Berlin. Few philosophers of an age which has produced a Faraday and Brewster have attained distinction equal to that which he earned for himself. His mathematical acquirements and his discoveries in astronomy, in optics, in chemistry, and in photography were all of a very high order, and such as, aided by an admirable style, secured for him the widest reputation among men of scionce, both at home and abroad; while his numerous popular writings have largely contributed to the diffusion of a taste for science, and an acquaintance with its principles among our countrymen.

Sir John Herschel married in 1829 Margaret Brodie, daughter of the Rev. Dr. Alexander Stewart, by whom he had a family of nine daughters and three sons. One of the former is married to General the Hon. Alexander Gordon, uncle of the present Lord Aberdeen, and now heir presumptive to that title. His youngest son is an officer in the Royal Bengal Engineers. He is succeeded in the title by his son, Mr. William James Herschel, of the Bengal Civil Service, who was born in 1833, and married in 1864 Miss Anne Emma Haldano Hardcastle, daughter of the late Mr. Alfred Hardcastle, of Hatcham, Surrey.

FUNERAL OF SIR JOHN HERSCHEL.

The funeral of Sir John Herschel took place on Friday, the 19th of May, at Westminster Abbey, in the presence of a large circle of attached friends, nearly all the men of science of the day, and a numerous assemblage of the public, who filled the sides and west end of the nave. At 12 o'clock the body, which had arrived by railway from Kent half an hour before at the Charing Cross Station, in a hearse attended by a single mourning coach, was carried into the nave by the cloister entrance, as the choir, accompanied by the organ, sang the well-known sentences beginning "I know that my Redeemer liveth." The procession having wound its way up the nave and reached the sacrarium, the coffin, which was of plain polished oak, with a plate bearing the following inscription:

"Sir John F. W. Herschel, Baronet,
Born 7th March, 1792;
Deceased 11th May, 1871."

was placed on trestles before the altar. The lesson was read by Archdeacon Jennings. The remaining portion of the service was sung at the grave by the choir, except the part read by the Dean, and it concluded with the anthem of Handel, "His body is buried in peace; but his name liveth for evermore." The Dean gave the final blessing. The Canons present on the occasion were Canon Nepean, Canon Jennings, and Canon Protheroe, and the whole body of minor canons attended. The grave is at the eastern end of the north aisle, near to the tomb of Sir Isaac Newton, under the painted window recently erected to Robert Stephenson, and at the foot of the monument to Lord Livingston. The pall-bearers were—the Duke of Devonshire, Chancellor of the University of Cambridge; M. le Duc de Broglie, Member of the Institute of France; Mr. George B. Airy, the Astronomer Royal; General Sir Edward Sabine, President of the Royal Society; Sir Charles Lyell; Mr. William Lassell, President of the Royal Astronomical Society; Sir Henry Holland, President of the Royal Institution; and Sir John Lubbock. The list of mourners included

Mr. A. S. Herschel, chief mourner, General the Hon. A. Gordon, Mr. Reginald Marshall, Mr. John Stewart, Messrs. Edward and Henry Hardcastle, Mr. William Spottiswoode, Dr. Parry, Bishop Suffragan of Dover; Mr. H. C. Morland, Mr. J. P. Gassiot, Colonel Strange, Mr. G. R. Waterhouse, the Rev. Charles Pritchard, Savilian Professor of Astronomy; Mr. J. H. Nelson, Mr. A. J. Beresford-Hope, M.P., Professor Tyndall, Professor Owen, Professor Adams, the Rev. J. Jeffreys, and Sir Charles Wheatstone. Among those also present in the Abbey were Sir John Bowring, Mr. Charles Darwin, the Dean of Salisbury, Messrs. Norman Lockyer, M. D. Conway, and Warren De la Rue, Professor Sylvester, Lady Augusta Stanley, and several other ladies, and a large number of men celebrated in every department of science.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

THE COLOUR OF JUPITER'S BELTS.

Sir,—It does not seem quite clear what was the real point of issue in the discussion on this subject, reported on pp. 107-9 of the *Register*, but the colour of the equatorial zone has latterly been dwelt upon so fully, that readers of the report only will naturally conclude that the fact of extensive change in that part of the planet is disputed by most of the eminent observers who took part in the discussion. Considerable weight was attached to the argument of the uncertainty of judgment as to colour, when observations are made at different times, and especially with instruments of diverse powers. May I be excused, in view of this, for the following remarks?

I made a good many observations of the planet with my 9-inch "With-Browning" reflector, during the apparition of 1868, and always saw the equatorial zone white, without any more trace of colour than faint marbling, apparently the darker body appearing through the thinner edges of masses of clouds, and once a faint streak. My latest note on this point in 1868 was made Dec. 23. I have mentioned on p. 173 of the last volume, that I first saw this zone yellow, August 28, 1869, while another zone N. was *very* white. I am not aware of any published observations before Mr. Browning's paper to the R. A. S., November 12. Acknowledging difficulties where colour is concerned, is there any possible explanation of observers independently seeing these zones with strongly contrasted tints, and using terms of similar import, excepting the objective character of the colours themselves? These may be what they were in 1862, but assuredly not as in 1868.

It is commonly stated that the principal belts are ruddy, but they are by no means invariably so; the proof of this is in character with that of the yellow zone above mentioned.

Some of the simultaneous appearances may be placed together:

N. tropical.	S. tropical.
Brownish, fading into yellow on the lower side.	[Double both.] Bluish grey.
Yellowish brown.	Lower streak, brownish. Upper, bluish grey.
Bluish.	Brown.

The N. temperate belt has been seen bluish grey.

Let us hope careful notes will continue to be made, and some day interesting results will appear. I am, yours truly,

London: May 13, 1871. T. H. BUFFHAM.

LUMINOUS BODIES SEEN BY DAY.

As interest has sometimes been excited by accounts of meteoric bodies (? seeds) being seen in the telescope by day, I may mention that about 2 p.m. yesterday, while trying to pick up Mercury, a bright object sailed across the field of my telescope. At the moment I imagined it was Mercury, and that the instrument had not been clamped, and had thus swung passed the object. But another and another went by, and there was evidently more than one Richmond in the field. Their direction was from the north-east apparently, indicating of course south-west. The weather-cocks when consulted pronounced the breeze north-east, but some smoke was noticed blowing from the westward, while some grass thrown up went in no fixed direction. As the telescope, however, was focussed for a planet, anything seen at all distinctly in it must have been at a considerable elevation. More than a dozen of these luminous objects passed, slightly varying their direction, and one, it was thought, described a somewhat curved path. My own impression was that they were floating seeds illumined by the sun, then shining brilliantly, and the season is favourable to this interpretation. A power of 30 was used on a 3¾-inch refractor.

Ventnor: May 9, 1871. G. GUYON.

SKETCHING WITH THE TELESCOPE.

Trifling hints in matters of contrivance are sometimes useful. In sketching planetary features on the observatory slate, white markings are made upon a dark ground, the reverse of the objects pourtrayed. I find a child's *transparent slate,* which costs from 4*d.* to 1*s*., a useful article for this purpose. Mine is about nine inches by seven, and in place of the usual pictures, a piece of cardboard is fitted, on one end of which are pasted a blank diagram of Mars and another of Jupiter, side by side. These showing through the ground glass, allow drawings to be made. After this the cardboard may be turned upside down, which brings the diagrams under clean portions of the ground glass, ready to receive fresh sketches. Black paper covers the reverse side of the cardboard, on which is pasted a circular piece of white paper, the size which the sun appears with my lowest power giving a whole-disc view; with this the solar spots can be sketched in their respective positions. Of course, as with the ordinary slate, the sketches are intended to be afterwards copied. The glass should be finely ground, and a soft lead pencil used lightly.

Ventnor, Isle of Wight: G. GUYON.
May 9, 1871.

AURORA BOREALIS OBSERVED AT FLORENCE ON THE EVENING OF THE 18th APRIL.

By G. B. Donati.

Last night whilst making preparations for observing a small comet now visible in the constellation of Perseus, we were all at once surprised by the appearance of an uncommon reddish light in the N.W. It was a very fine aurora, which extended on the horizon 40 degrees from the breast of Perseus as far as the crown of Cepheus. It was formed of a great arc of blood colour light, terminated at the extremities by two rays longer and more brilliant than the arc. The ray or streak on the west was the higher and the more luminous; it passed a little beyond α Persei, that is to say, it was about 30 degrees in altitude. The other ray in the north, which was fainter, was about 25 degrees in altitude. This was precisely at 9 o'clock At 9h. 20m. the two rays altered their position about 10 degrees towards the north, and their light began to vary at intervals; the western ray diminished, and the northern became more luminous. Five minutes afterwards, the light underwent a great and almost instantaneous dimunition. At 9h. 24m. a very luminous bolide traversed the constellation of Boötes. At 9h. 30m. the aurora had entirely disappeared, but where it had appeared there was seen a diffused and whitish light, which lasted till after 11 o'clock.

Although this aurora was very inferior to the very beautiful one which was seen in Florence and throughout all Italy on the 24th October, last year, yet it must be ranked amongst those of rare beauty in our climates. That which surprised me in the aurora of the 24th October, was the sudden cessation of a very strong wind as soon as the aurora appeared. Yesterday, likewise, a strong south-east wind which was blowing, immediately ceased at the moment of the aurora. We have learned this morning by telegraph that the aurora was observed also at Urbino, and at S. Giovanni in Persiceto. . . . . Extraordinary magnetic perturbations were remarked yesterday in various places. One needle marked last night, at 9 o'clock, a declination much greater than usual, and from 9h. to 11h. the declination diminished by degrees 25 minutes of arc, in an unusual manner.

Donati makes some concluding reflections on the certain but still mysterious link which unites the three phenomena of the solar spots, terrestrial magnetism, and polar auroras.

Florence: 19th April, 1871.

RECENT PUBLICATIONS.

The Great Pyramid of Jizeh; the Plan and Object of its Construction. Cincinnati: Robert Clarke, 1871.

This pamphlet is simply a repetition of the arguments brought forward by Professor Piazzi Smyth and others, in defence of the Pyramid being a divinely inspired work as a standard of measure. It also enters into the very doubtful question of the Anglo-Saxons being the lost tribes of Israel. "Ho, ho! come forth and flee from the land of the North" (*i.e.*, north quarter of Europe). "Israel and Judah shall be brought together and made one nation."

"Were the blind eyes opened," says the writer, "it is quite possible that even in this *New World* of ours, one would suddenly come to the realisation that he was dwelling in the midst of the teeming multitudes of Israel terminating their emigration in a land long promised, long reserved; under the government of a commonwealth restored; free from every taint of *caste*, condition, or kingly rule." It is but fair to say that he prefaces his tract with the observation that any discovered solution of such subjects must be received with very much reserve.

We are glad to see the new volume of *Results of Astronomical Observations made in the Melbourne Observatory, in the Years* 1866, 1867, and 1868; under the direction of R. L. J. Ellery, the Government Astronomer. Published by Authority of the Government.

The astronomical work with which the Melbourne Observatory was occupied during these years, consisted almost entirely of observations for the determinations of the fixed stars, made with the transit circle and with the east transit instrument. The observations with the latter instrument, however, form part of the Survey of the Southern Heavens, now being prosecuted by the Cape of Good Hope, Madras, and Melbourne Observatories. The results of the Transit Circle Observations only are given in the present volume.

The Meteoric Theory of Saturn's Ring. By Augustus Morse Davies, B.A., F.R.A.S., M.R.I., P.A.C., Lieut. Royal Artillery. Longmans, 1871.

Mr. Davies in this volume has brought together and further reasoned out the arguments in favour of the ring of Saturn being an appendage due to the planet having encountered and attached to itself myriads of meteoric satellites during its wanderings through space. The book concludes with a discussion of the meteoric origin of the Sun's heat and power.

Mr. Davies disbelieves in the true existence of the solar corona as a real solar appendage. The book is profusely illustrated with diagrams.

The Romance of Motion. By Alec Lee. London: Longmans, Green and Co.

The object of this pamphlet is best shown by the following extract from the preface. "The opening remarks on the paper on motion are designed to show that the position presently held by astronomy with regard to the motions and velocities of the planetary bodies is not unassailable, and the other portions are devoted to the consideration of their peculiarities on the hypothesis that the ether in space is a material substance, and that the various world systems are upheld by the continued operation of a duality of forces, and not, as heretofore alleged, by one well directed primal impulse, acting in combination with one continuous force of gravitation."

So with the analyses and syntheses of nitrogen.

"If the subject were reasoned out a little further than appears in the context, the oceans of the air and the water might be found to be the two great reservoirs of the organic matter of our planet, &c. Should the principle of this analysis prove correct, we may come to a consciousness of the possibility of such further reduction of our simple bodies as must ultimately point to a common origin for all things."

Most modern physicists believe the ether to be a real substance, and if it is so, doubtless it must act upon the motions of the heavenly bodies. This little tract tentatively and hypothetically treats of this influence, and more especially of the possible influence of magnetic and diamagnetic forces upon the planetary bodies. The subject of motion, as well as of simplification of elements, is full of interest, but it will be many years, probably, before any amount of reasonable certainty is arrived at with respect to them.

NOTES FROM THE SOUTHERN HEMISPHERE.

Sir,—Mr. H. C. Russell, the Government Astronomer for New South Wales, has just published a very interesting and important pamphlet on the wonderful mysterious nebula surrounding η Argus.

On comparing Mr. Russell's map with Sir J. Herschel's, in his Cape Observations, a most unmistakable proof of change in the form of the nebula is at once seen.

Thinking the publication in question might be of use to the *Register*, and prove interesting to its readers, I enclose a copy.

On the night of the 23rd and 24th March, a most remarkable aurora was seen in Sydney from about 9.30 p.m. to 2 a.m. (Greenwich mean civil time, March 23rd, 11·30 a.m. to 4 p.m.). I send a cutting from a Sydney paper, with Mr Russell's Report. It would be interesting to learn whether any disturbance was noticeable in Europe at the same time.

I remain, yours truly,

Sydney, 25th March, 1871. W. J. MACDONNELL.

[We wish it was in our power to give our readers, as an illustration, the beautiful map accompanying this tract, without which we fear we could not convey any valuable information upon the subject. The observations were made with an equatorial 7½-inch aperture and 10-foot 4-inch focal length. The writer believes that changes have taken place in this great nebula since Sir John Herschel was at the Cape, and that there is a probability that the changes will still go on. We add the account of the aurora sent by our correspondent.—*Ed.*]

BRILLIANT AURORA AUSTRALIS.—For a considerable time before and after midnight on Thursday there was visible in Sydney an aurora of most brilliant hue. Stretching in a regular arch of large diameter, from the horizon at the south-east to the south-west, from the point of the Milky Way under the constellation Scorpio almost to Sirius, covering the Magellan Clouds and reaching up to the star Canopus, was a broad belt of red cloud-like light, and darting up from the horizon streaks of white flashed across the face of the clouds. At one time a cluster of these white streaks, formed in the centre of the arch, where the belt of red cloud was the widest, gave it the appearance of an immense organ. Every moment the form and hue of the aurora changed. Sometimes there was not a streak to be seen—nothing but the diffused red cloud, like the reflection from an immense fire; then in a second straight lines of light would dart from the south. The whole pageant faded and almost vanished, and again as suddenly burst forth with lurid glare. The most brilliant appearance observed was from ten to fifteen minutes past twelve. At half-past twelve there was scarcely a trace left of the magnificent illumination. After the above was written we were favoured by H. C. Russell, Esq, Government Astronomer, with the following remarks on this beautiful phenomenon:—"Brilliant aurora began at 9.35 p.m. in S.S.W., rose pink, and about 15° high; at 9.38 one bright white streamer shot up to 20°, in S.S W., followed by another due S., at 9.39, then one between them, and then several smaller ones near the large ones; streamers lasted about three minutes, then faded; the auroral light extended from S.W. to S.E., and when highest rose to 20°, and was deep red. At 9.50 it had nearly faded, but increased again at 10 p.m.; at 10.3 p.m. faded again; at 10.4 p.m. white light was observed under the red, and immediately afterwards another ray started up to 20°, rather wider than the previous ones, and red in colour. About midnight it again became bright, and auroral light was visible to S. all night. This is the finest aurora seen here since 24th September last, and seems to have been visible over the colony, as it was well seen at Eden and Newcastle."

THE TRANSIT INSTRUMENT AT DUBLIN OBSERVATORY was erected in 1808, it having been ordered in 1783. This delay was in one respect fortunate. Ramsden having quarrelled with Usher, resolved that the latter should never have the circle. On Usher's death, Ramsden set to work to complete it but found to his dismay, that the extremities of its radial arms had become "rotten," having been acted on by the sulphurous atmosphere of London. As originally constructed, it was ten feet diameter. He removed the rims (which, I believe, had been also acted on), cut away about six inches from each of the arms, and found the remainder sound. But as he was doubtful about its permanence he let it lie several years longer, and found his apprehensions verified. He cut off six inches more from each arm, and awaited the result, notwithstanding the urgent expostulations of Brinkley; and it was not until a short period before his death that he was satisfied that no farther change was probable. He then completed it at its reduced diameter of eight feet. But it was not divided till after his death (by Berge, his successor). It is not easy to explain why this destruction was confined to the ends of the arms. To judge from the analogy of the Palermo circle, the diameter of these arms at the outer extremity was very small; and if they were of cast brass, the molecular condition of the metal there, in consequence of the more rapid cooling, may have been different from that of the more massive portions. A still more remarkable instance of this destructive action occurred to a circle described by Mr. Bond in the *Philosophical*

Transactions, 1806, and known as the Westbury circle. This was ultimately established at the old Observatory of the Glasgow University, and in an atmosphere still more sulphurous than that of London. When this University was broken up, and its instruments sold, this circle was purchased by the late Sir James South; but on its arrival at his Observatory, it was found to have suffered so much that it actually fell to pieces! Only a few of the more massive parts were entire; and of the rims of the circle nothing remained except that which carried the divisions, which, as I was informed by Troughton, was of "Dutch brass," and was quite unchanged. The excellence of this Dutch brass is, I believe, recognised also by watchmakers, and it seems to deserve inquiry to what its superiority over English brass is to be attributed. It is worthy to be mentioned that among the instruments ordered from Ramsden by Usher, was an equatorial telescope driven by clockwork. But owing to Ramsden's feud with Usher, this was not executed; and this important aid to the astronomer, which had been proposed by Hook nearly a century before, lay dormant till it was applied by Frauenhöfer, forty years later, to the Dorpat telescope.—Armagh: April 6. T. R. R.—*Nature.*

EDWARD TROUGHTON, the celebrated astronomical instrument maker, could never distinguish colours otherwise than by their brightness —a ripe cherry and its leaf were to him of the same colour.

BESSEL.—So expert had Bessel become in cometic calculations (when only 21 years of age), that Olbeis having placed in his hands, on the night of the 1st November, 1805, four observations of the comet of that year, he returned them to him the next morning, with the elements, whose calculation had occupied him only four hours.

SCHUMACHER remarked, "One may almost assert that one exact and able calculation is capable of doing better service to astronomical science, than two new observatories."

THE CORONA.—Dr. Schmidt having asserted that the commonly received opinion of the solar corona being alluded to by Philostratus was unfounded, Professor Grant sends a note to the *Astronomische Nachrichten* (No. 1838), to point out that Schmidt had got hold of the wrong passage. In Book VIII. and chapter xxii. of the said writer's *Life of Apollonius of Tyana*, is an allusion which seems to have escaped Schmidt's notice, and which Grant considers beyond all doubt to refer not only to a solar eclipse, but to specify that attention had been directed to the corona as an incident of the eclipse.

OBSERVATIONS FOR JUNE, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich midnight		60°N.		0°		60°S.
			SUNRISE.			
		°		°		°
1871. June 1	...	−73·6	...	−74·5	...	−75·5
2	...	−85·8	...	−86·7	...	−87·6
			SUNSET.			
3	...	+80·3	...	+81·1	...	+82·0
4	...	68·1	...	68·9	...	69·8
5	...	56·0	...	56·7	...	57·5
6	...	43·8	...	44·5	...	45·3
7	...	31·7	...	32·3	...	33·0
8	...	19·5	...	20·1	...	20·8
9	...	+7·3	...	+7·9	...	+8·5
10	...	−4·8	...	−4·3	...	−3·8
11	...	17·0	...	16·5	...	16·0
12	...	29·2	...	28·7	...	28·3
13	...	41·4	...	41·0	...	40·6
14	...	53·6	...	53·2	...	52·9
15	...	65·8	...	65·5	...	65·2
16	...	−78·0	...	−77·7	...	−77·5
			SUNRISE.			
18	...	+77·9	...	+77·8	...	+77·6
19	...	65·6	...	65·5	...	65·4
20	...	53·3	...	53·3	...	53·2
21	...	41·1	...	41·0	...	41·0
22	...	28·8	...	28·8	...	28·8
23	...	16·5	...	16·5	...	16·6
24	...	+4·2	...	+4·3	...	+4·4
25	...	−8·1	...	−7·9	...	−7·8
26	...	20·3	...	20·1	...	20·0
27	...	32·6	...	32·3	...	32·1
28	...	44·8	...	44·6	...	44·3
29	...	57·1	...	56·7	...	56·4
30	...	−69·3	...	−68·9	...	−68·6

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JUNE, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight. ° ′	Objects to be observed.
1	18 4·4	Seleucus, Briggs, Lichtenberg.
2	3 50·2	Aristarchus (*a*), Hercynian Mts. (*b*)
20	148 10·3	Mare Crisium (*c*), Apollonius, Firmicus.
21	136 54·9	Cepheus, Franklin, Oersted.
22*	125 27·0	Piccolomini, Riccius, Stiborius.
23	113 43·8	Altai Mts., Polybius, Beaumont.
24	101 42·5	Alfraganus, Theon Senr. and Junr.
25	89 20·5	Palus Nebularum, and P. Putredinis (*d*).
26	76 35·9	Gauricus, Pitatus, Guerikè.
27	63 28·2	Helicon, Leverrier, Euler (*e*).
28	49 58·2	Riphean Mts., Euclides.
29	36 9·5	Gassendi (*f*), Mersenius, Percy Mts. (*g*)
30	22 7·5	Damoiseau (*h*), Aristarchus (*i*), Herodotus.

The lists for February and April may be consulted for additional objects, which will be readily given by the position of the terminator.

* Spring Equinox, N. hemisphere.

(*a*) Compare Browning's drawing at full moon, *Student*, April, 1869, p. 129, and note positions of bright spots near.

(*b*) The enclosed plain has been named "Otto Struve."

(*c*) The direction and form of the central ridges should be well studied.

(*d*) The fine mountain scenery furnishes ample material for close scrutiny and study.

(*e*) An apparently ancient formation, to the east of Copernicus, may be seen on or near the terminator.

(*f*) It is important, in a selenological point of view, to determine the exact character of the central mountains in Gassendi.

(*g*) The mountains between Gassendi and Mersenius.

(*h*) The Rev. T. W. Webb calls attention to a remarkable formation on the N. of Damoiseau.

(*i*) Late observations appear to indicate that the floor of Aristarchus is not *flat*. M. Gandibert calls attention to a valley on the N.W. of Herodotus (see *English Mechanic*, No. 320, May 12, 1871, p. 180), which was observed on May 1, 1871, to be the commencement of the great Serpentine cleft.

Erratum in last list.

May 26. For *Renuker*, read *Rumker*.

ASTRONONOMICAL REGISTER—Subscriptions received by the Editor.

To July, 1871.

Lewis, H. K.

To Sept., 1871.

Buffham, T. H.

To Dec. 1871.

Adams, S.
Crowe, Rev. R.
Green, N. E.
Turberville, H.
Varley, C.

To Jan. 1872.

Shaw, Rev. J.

May 20, 1871. Subscriptions after this date in our next.

ASTRONOMICAL OCCURRENCES FOR JUNE, 1871.

DATE.		h. m.	Principal Occurrences.	Jupiter's Satellites.	h. m. s.	Meridian Passage. h. m.
			Sidereal Time at Mean Noon, 4h. 38m. 6·80s.			Moon. —
Thur	1	10 19	Near approach of ζ^1 Libræ (4)			10 42·3
		10 46	Occult. of ζ^3 Libræ (6)			
		11 57	Reappearance of ditto			
		12 1	Occult. of ζ^4 Libræ (6)			
		13 10	Reappearance of ditto			
Fri	2	18 26	○ Full Moon	2nd. Sh. E.	9 0	11 42·0
		7 39	Occultation reappearance of ψ Ophiuchi (5)			
Sat	3	7 6	Conjunction of Mars and β Virginis, 0° 2′ S.			12 45·0
		12 30	Conjunction of Mars and β Virginis, (0·2m.) W.			
		19 0	Conjunction of Uranus and Venus. 1° 46′ N.			
Sun	4	11 39	Conjunction of Moon and Saturn, 1° 28′ N.			Arcturus —
		11 34	Near approach of B.A.C. 6369 (6)			9 14·4
Mon	5		Sun's Meridian Passage, 1m. 53·90s. before Mean Noon			9 14·24
Tues	6					9 16·5
Wed	7					9 6·5
Thur	8	13 8	Occult. of τ^1 Aquarii (6)			9 2·6
		13 54	Reappearance of ditto			
		14 15	Occult. of τ^2 Aquarii (4)			
		15 24	Reappearance of ditto			
Fri	9	12 37	☾ Moon's Last Quarter			8 58·7
Sat	10					8 54·7
Sun	11		Saturn's Ring: Major Axis=41″·32 Minor Axis=17″·83			8 50·8
Mon	12					8 46·9
Tues	13	14 54	Occult. of B.A.C. 830 (6)			8 42·9
		15 35	Reappearance of ditto			
Wed	14					8 39·0
Thur	15	12 43	Conjunction of Moon and Mercury, 0° 20′ S.			8 35·1
			Illuminated portion of disk of Venus=0·648			
			„ of Mars=0·883			

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Fri	16		Sidereal Time at Mean Noon, 5h. 37m. 15·17s.			8 31·1
Sat	17	14 29 12 0	● New Moon Conjunction of Mars and η Virginis (10 2m.) E.			8 27·2
Sun	18	9 20	Conjunction of Moon and Jupiter, 0° 29′ S.			8 23·3
Mon	19	23 50	Conjunction of Moon and Uranus, 1° 41′ S.			8 19·3
Tues	20		Sun's Meridian Passage, 1m. 8 13s. after Mean Noon			8 15·4
Wed	21	11 59	Conjunction of Moon and Venus, 1° 43′ S.			8 11·5
Thur	22					Moon. — 3 38·5
Fri	23					4 26 0
Sat	24					5 12·7
Sun	25	10 44 7 10	☽ Moon's First Quarter Conjunction of Moon and Mars, 5° 36′ S.			5 59·1
Mon	26					6 46·3
Tues	27	8 32 9 42	Occultation of 94 Virginis (6) Reappearance of ditto			7 35·3
Wed	28	7 15	Opposition of Saturn			8 27·4
Thur	29					9 23·4
Fri	30	4 14	Conjunction of Jupiter and the Sun			10 23·7
Sat	JULY. 1	10 23	Conjunction of Moon and Saturn, 1° 16′ N.			11 27·4

THE PLANETS FOR JUNE.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	3 16 19	+ 14 6½	9″·8	22 34·5
	15th	4 3 27	17 52½	7″·2	22 26·5
Venus ...	1st	7 32 5	+24 2½	15″·5	2 53·5
	15th	8 38 34	20 39½	17″·3	3 4·7
Mars ...	1st	11 41 42	+2 50	11″·3	7 2·4
	15th	11 59 43	0 28	10″·1	6 25·4
Saturn ...	1st	18 36 33	−22 23½	16″·6	13 56·2
	15th	18 32 33	22 28	16″·6	12 57·1

Mercury is a morning star during the month, but too close to the sun to be much worth observing.

Venus is well situated for observation.

Mars is visible throughout the night till early morning. On the 25th he sets twice, and for the rest of the month sets before midnight.

Saturn rises between sunset and midnight till the 24th, when he rises at sunset, after which date he will rise before sunset and be visible throughout the night.

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APPENDIX TO THE *ASTRONOMICAL REGISTER*.

No. 102.

READINGS FROM THE BORGIAN GLOBE.

(See *Astronomical Register*, No. 97, January, 1871.)

A CAREFUL examination of the planispheres in Asseman's work proves them to have been very faithfully executed. Notwithstanding the frequent ambiguity or obscurity of the Cufic letters, many names are readily made out; and even the tracings of such as are doubtful often suggest an almost certain emendation of some of the readings of Asseman. The general result shows an almost perfect accord between the names in Ulugh Beigh and other authorities, and those on the globe. That many words are nearly alike, especially when not clearly written, in Arabic, which are unlike in Roman characters, will be borne in mind by the reader in perusing the following notanda. Explanations of names not given here will be found in "Arabic names of the stars, &c." in No. 97. An asterisk is affixed to names not included in that list. A. stands for Asseman.

URSA MAJOR. ξ *Alhiac*, the ostrich (A.), is probably *al-'anák*. η *Alcatel*, the slayer (A.), is very probably *al-kaid*. ϵ, *alhút*, the great fish (A.), is very probably *al-jaún*, or *al-hawar*. The unformed stars, since made by Hevelius into Leo Minor, are enclosed in a pear-shaped figure, and named *aldhibá wa auládhuha*,* the antelopes and their young; as Smyth also notices, *Cycle*, vol. 2, p. 248. To one of them A. reads the name *al-shaukat*, the thorny plant, or *mabsutah*, stretched out, but the reference is mistaken, and the words are plainly *dhirá'-al-mabsutah*, and relate to Gemini. 12 and 8 in Canes Venatici (a constellation made by Hevelius) are enclosed in a little parallelogram, to which A. reads *Karab-al-abl*, the camel's pack, but which very probably is *Kabd-al-asad*.

DRACO. A. reads the name *Alghavil altannin*, and makes it to mean the poisonous dragon. The first word, however, is *al-'awáyid*, and refers to the stars in the head only. μ, *alcaab* (A.), the dish, is probably *al-rákis*. β, *al-zahr* (A.), the flower. Jauhari (Anglice, "Jeweller"), the compiler of the Arabic Dictionary called *Sahah*, accurate, says *Jauzahr* is the Arabic form of the Persian *Kúzahr*, meaning the place of poison. Perhaps *zahr* on the globe is part of this word put for the whole; though *zahr* (poison) is really Persian. Both *Jauzahr* and *Kúzahr* are used in Persian for the dragon's head and tail. In the first fold of the dragon's neck A. reads *algharanec*, the cranes. The word, however, is *alfirk*, and belongs to Cepheus, whose left side is entangled by the folds of Draco, in the planisphere. ι, *al-rubah*, the camel's foal, or *al-dhík*, the wolf (A.), who prefers the latter, and it seems to be the better reading. Three other names, which A. could not make out, seem to be ζ, *al-dhib*, the wolf; over η, *al-dhibain*, the two wolves or jackalls; *al-athâfí*, one of the stars of the tripod.

Boötes. According to Hyde, *al-'auwá*, the shouter, was owing to a misapprehension of the Greek name, as though it was derived from boân, to shout. (There is a Greek word, boátes, crying.) κ, θ, ι, λ, *aulad al-nadhlat*, the children of contention (A.) is *aulâd al dhiba'*; the Cufic, however, as in other cases, might easily be mistaken for A.'s reading. ε, *almizat*, reaping hook or curved weapon (A.), obscure; probably *mízar*, girdle. η, *al-ramh*, the spear. α, *al-rámih*, the lancer.

Corona Borealis, α, *munír-min alfekkah*, the bright one of the platter.

Hercules. *Al-játhí fainnahu al-rakis*, "the kneeler," and he is also "the dancer" (A.) But the last three words are *'alá rukbeteihi*, on his knees. On the right arm, however, of the figure, are the words *wa al rakis*, and the dancer, not mentioned by A., but evidently a continuation of the preceding inscription.

Lyra. Figured as a kind of ornament, or arabesque, something in the form of a tortoise. It has an inscription for which A. proposes three different readings, none of which are very probable. One is *almozafzef* (a bird) with wings partly extended, letting itself down gently. The word appears to be *al-migrafat*. α, *al-wákí'*.

Cygnus. *Al-ornis*, from Gr. ornis, the bird. α, *Ridf.*

Cassiopeia. β, *al-'azizat*, the exalted one (fem.) (A.). I suspect it is *Kaff-al-khadib.*

Perseus. Over the left shoulder, A. reads *mughammedh al thuraiya*, or *mukhammer al thuraiya*, both meaning, concealer of the Pleiades, or the Many; but I think the first word is *mi'sam*. ο, on the right heel, *sabik al thuraiya*, preceding the Pleiades (A.), but it may be *'átik al thuraiyá.*

Auriga. A man holding a scourge or whip. *Mumsik-al-'ainnat*, holder of the reins. α, A. reads *alcabelah*, as if for Capella; but as a derivation from the Latin is unlikely, he also proposes two other readings. I am disposed to think the word is meant for *al 'ayyúk*, or possibly *al-'atúd*, the kid. ε, *al'anz*,* the she-goat (by others called *al ma'z*, the goats). η, *al-hurr*,* the fawn.

Ophiuchus. To a conical figure between the left arm and Aquila, containing Taurus Poniatowski, is an inscription which A. was unable to read. I can only surmise it may be *al-rá'i'í-wa-Kaikas*, the shepherd, and Kaikas, the last word a corruption of Ophiuchus, to whom the inscription relates. A. could find no name in this constellation, but I think *al-ráa'í*, may be read over the head of the figure.

Aquila. In a triangular figure are five stars, afterwards Antinous, of which to δ and λ, A. reads *al-khalimain*, the two friends; but Smyth correctly has *al-dhalímain*,* the two ostriches. *Cycle*, vol. 2, p. 431.

Delphinus. A. has overlooked a word which seems plainly to be *al-'ukúd*, the knots, or necklaces, among the four stars.

Pegasus. θ, *Sa'd-al-melik* (A.) very indistinct, is perhaps *sa'd-al-baháim*. *Sa'd-al-melik* is properly α Aquarii about 7° below. α, *mokaddem*, for the full form. τ and υ, *almanar* (A.), I believe the true reading is *al-kereb*. A. remarks that the mishapen and confused lettering in Pegasus renders it impossible to do more than conjecture its meaning, but upon the whole he has been very successful.

Andromeda. ν, *alaamac* (A.), is *al-a'nák*. β, *batn al-hút*, referred by A. to Pisces, seems to belong to Andromeda in the planisphere. α, *al-sarrat*, the navel, plainly written, though not noticed by A. Three straight lines, and the hinder part of Pegasus mark off a space in which is α

Andromedæ and γ Pegasi, and *al fargh al-muachchir*, is written between them. Half of the head of Andromeda is included in this space.

TAURUS. Aldebaran is called also *alfanik*,* the camel or horse-stallion. Hyades, called also *alkaláïs*,* the young camels. (Alferghani.)

GEMINI. ϵ, *al-dhira* (A.) should be *al-dhirá' al-mabsútah* (see under Ursa Major).

CANCER. Præsepe, *al-nathrah* is called also *Fom al-asad*,* the lion's mouth. (Alferghani.)

LEO. *Al-tarf*,* the eye; two small stars called also *'aïn-al-asad*,* the lion's eye (Alferghani). 12 and 13 (6th magn.) occupy this place in our maps. Tizini calls λ the northern one of *al-ta·f*, and κ the northern one of the nostrils.—*Note.* κ is *minchir-al-asad*, according to Ulugh Beigh, not λ, as I before wrote. *Al-tarf* may possibly have been λ and κ. *Al-jabhah*, ζ, γ, η (Ulugh Beigh), including Regulus (A.). Smyth remarks that γ is improperly so called; "for," he says, "no representation of the lion which I have examined will justify that position." There seems to have been some variation or confusion in this asterism. Perhaps *jabhah* means here the front generally, rather than the forehead. δ and θ are also called *al-khárátan*,* the guides (?) (Alferghani).

VIRGO. a, *alaghzal* (A.) should be *al-'a'zal*.

SAGITTARIUS. *a'ïn al rámí*,* ν^1, ν^2 (?), eye of the archer, "a nebulous pair" (Ulugh Beigh). *'Urkúb-al-rámí*,* β, the hough or pastern of the archer (so Ulugh Beigh). δ, *al-wasl*,* the joining or union; perhaps of the hand and the bow; or of the cusp and the shaft; or if the name is ante-Ptolemaic, it perhaps signifies the place where the two herds met, coming to and returning from watering. *Al daffa al rámí*, referred by A. to a star in the off foreleg. ϵ, or β, Telescopii (?), and explained by him as "the half of the archer." But it may be an error for some other word, perhaps *al na·l al-rámi*, and seems to refer to γ in the planisphere. A. has not noticed a word on the hind-quarters, which I read *al-'azaïzá*,* the buttocks, probably 62. *Al-baldat*,* the city, the space between the archer's shoulders and the horns of Capricorn.

CAPRICORN. *Shát*,* a sheep, would seem to be π, but according to Ferghani it is a^1, the smaller star close to a^2, the northern *Dhabih*, or slaughterer. δ, *Dheneb al-jedí*,* the goat's tail (Ulugh Beigh).

AQUARIUS. a, A. has *sa'd-al-kol*, a misreading for *sa'd-al-melik*. I think I read *dalw*, or *al-dalw*, over the urn. Fomalhaut is included in this constellation. In characters unusually large and clear, it has the inscription, *al difda' al awal wa huwa al dhalím*, the first frog, which is also "the ostrich."—*Note.* δ. Skat (maps) may after all be for *sák*, the leg or shank.

CETUS. A. reads *al baka*, among the stars in the body. It seems to be *al-na'ámát*, the ostriches.

ORION. a, *yed-al-jauza*,* hand of the Jauza. γ, *al-dahar* (A.) seems to be *al-nájid*. π^1, π^2, &c., *al-dawáir* (A.), the circles, should be *Dhawáib*, forelocks.

ERIDANUS. a, *ákher al nahr wa huwa al dhalím*, the end of the river, which is also "the ostrich," in clear bold letters. *Al kaff aljeria* (A.) who refers it to the bend in the river; but it refers to γ Ceti, and is *kaff-al-jidhmá*. The words Angetenar, or anchenetenar, mentioned by Cœsius, may be a corruption of some word like *mahniyat-al-nahr*, the bend of the river; perhaps η.—*Note.* Theemin (maps) the eighth, perhaps marks the 8th bright star in the river, beginning with a. 8 are laid down in the planisphere.

LEPUS. A word beneath the hare's feet, very illegible, may be conjectured to be *nihál* or *kursá*.

Canis Major. *Aloori* (A.) is *al-a'dhára*, η, ϵ, &c. *a*, *al-yemaniyah al a'búr*, the Yemanite, the crossing; called also *Kelb-al-jabbar*,* the giant's dog. (Abdurrahman Sufi.) *Al-furúd* is inscribed in a quadrangular figure, enclosing seven stars of the unformed of Canis Major, since made into Columba, not including ζ.—*Note.* Phaet (maps) may possibly be a corruption of *furúd*.

Canis Minor. ' *a*, *al shámiyah al ghomeïsá*, the Syrian, the watery-eyed.

Corona Australis. Described by A. as without any of the embellishments of the other constellations, and "as if thrown down at the feet of Sagittarius." Thus Germanicus spoke of it as "sine honore corona," for no legend was attached to it. 150 years later, Ptolemy gave it its present name, which when the globe was made had the respectable antiquity of above 1,000 years; yet the configuration of its stars, and the name, without any drawing, is all that was allowed it. It would be desirable in our own maps and globes, when the delineations of the figures of the ancient constellations are given, that they should be presented with scrupulous accuracy; but all others may well be omitted, retaining only the names and boundaries as given by Hevelius, La Caille, and others. In the standard lists of the constellations in Hind's *Astronomy*, and in Chambers' *Descriptive Astronomy*, a quantity of rubbish introduced into the heavens in later times has properly been rejected.

The number of names on the Borgian Globe, after revising A.'s readings, is 138, allotted as follows:—Pegasus, 11; Ursa Major, 10; Draco and Sagittarius, 8 each; Aquarius, 7; Boötes, Orion, and Canis Major, 5 each; Cepheus, Perseus, Auriga, Andromeda, Leo, Capricorn, 4 each; Hercules, Aries, Virgo, Scorpio, Cetus, Ursa Minor, 3 each; Lyra, Cygnus, Cassiopeia, Ophiuchus, Delphinus, Taurus, Gemini, Eridanus, Lepus, Canis Minor, Argo Navis, Centaurus, 2 each. The rest have 1 each, except Sagitta, Equuleus, and Lupus, which have none.

GEORGE J. WALKER.

24	... 93 8·4	...	Archytas, craters between it and Egede.
25	... 80 9·5	...	Craters and mountains between Archimedes and Plato (*e*).
26	... 66 54·6	...	The Alps and wedge-shaped valley (*f*).
27	... 53 25·2	...	Ramsden, remarkable valley and clefts in its neighbourhood.
28	... 39 44·4	...	Horrebow, its interior wall Harpalus.
29	... 25 56·9	...	Scheiner, Blancauus, Gruemberger.
30	... 12 8·6	...	Wargentin, Schiller.
31	... —1 32·7	...	Crüger, Byrgius, Rosse (*g*).

For additional objects consult the lists for March and May.

(*a*) This formation is not open on the south, as shown in our maps. It has a nearly filled ring on its N.W. border (see *English Mechanic*, No. 323, June 2, 1871, p. 261).

(*b*) A region west of the Pyrenees, containing craters named after celebrated navigators, Magelhaens and others (see *Monthly Notices, R. A. S.*, vol. xxiv., p. 20).

(*c*) Determine succession and direction of peaks as they come into sunlight.

(*d*) Named to commemorate the architectural labours of the Gwilts.

(*e*) On May 26, Piazzi Smyth and Rumker were not in sunlight; look for them on July 25.

(*f*) Examine the interior for craterlets.

(*g*) See *Monthly Notices, R. A. S.*, vol. xxiv., p. 20.

Errata in No. 102, p. 147, line 12 from bottom, for *calculation* read *calculator;* line 16 from bottom, for *Olbeis* read *Olbers.* Page 149, line 2 of (*i*), for *Gandibert* read *Gaudibert.*

THE PLANETS FOR JULY.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	5 57 31	+23 37½	5″·4	23 17·3
	15th	7 58 33	22 26	5″·0	0 26·9
Venus ...	1st	9 47 11	+14 56½	19″·9	3 10·3
	15th	10 40 1	8 57	23″·0	3 7·9
Mars ...	1st	12 25 16	—2 42	9″·1	5 47·9
	15th	12 51 2	5 44	8″·5	5 18·6
Saturn ...	1st	18 27 3	—22 33½	16″·6	11 49·2
	15th	18 23 12	22 36½	16″·6	10 49·8

Mercury is a morning star till the middle of the month : he sets a short time after sunset after the 8th.

Venus is still excellently situated for observation of an evening. Her illuminated portion gradually decreases throughout the month.

Mars is still an evening star, setting earlier each day ; at the end of the month setting about two hours and a quarter after sunset.

Saturn is visible all the night.

ASTRONOMICAL OCCURRENCES FOR JULY, 1871.

DATE.		Principal Occurrences. h. m.		Jupiter's Satellites.	h. m. s.	Meridian Passage. H. m. Saturn
Sat	1	 19 23	Sidereal Time at Mean Noon, 6h. 36m. 23·54s. Conjunction of Moon and Saturn, 1° 16′ N. Saturn's Ring: Major Axis=41·52″ Minor Axis=18·12″			11 49·3
Sun	2	1 36 13 23 14 34	○ Full Moon Occultation of χ′ Sagittarii (6) Reappearance of ditto			11 44·9
Mon	3		Sun's Meridian Passage, 3m. 49·15s. after Mean Noon			11 40·7
Tues	4	17 0	Near approach of ε Capricorni (4½)			11 36·5
Wed	5					11 32·2
Thur	6	19 12 21 21	Conjunction of Venus and α Leonis (7·8m.) W. Conjunction of Jupiter and Mercury, 0·59′ N.			11 28·0
Fri	7					11 23·7
Sat	8	11 52	Occultation reappearance of 20 Ceti (5½)			11 19·5
Sun	9	1 9	☾ Moon's Last Quarter			11 15·3
Mon	10	23 46	Superior Conjunction of Mercury			11 11·0
Tues	11					11 6·8
Wed	12	20 23	Conjunction of Venus and ρ Leonis (5·9m.) W.			11 2·5
Thur	13					10 58·3
Fri	14	14 47	Conjunction of Uranus and Mercury, 1° 14′ N.			10 54·0
Sat	15		Illuminated portion of disc of Venus=0·507 " of Mars=0·878			10 49·8
Sun	16	4 5	Conjunction of Moon and Jupiter, 1° 0′ S.			10 45·6

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
						Saturn
Mon	17		Sidereal Time at Mean Noon, 7h. 39m. 28·45s.			
		5 27	● New Moon			10 41·4
		9 1	Conjunction of Moon and Uranus, 1° 48′ S.			
		21 45	Conjunction of Moon and Mercury, 1° 1′ S.			
Tues	18		Sun's Meridian Passage, 5m. 48·32s. after Mean Noon			10 37·2
Wed	19	15 4	Conjunction of Uranus			10 32·9
		22 14	Conjunction of Venus and *c* Leonis, (2·4m.) W.			
Thur	20	23 51	Conjunction of Moon and Venus, 5° 27′ S.			10 28·7
Fri	21					10 24·5
						Moon.
Sat	22					5 7·9
Sun	23	14 45	Conjunction of Moon and Mars, 5° 51′ S.			6 1·9
Mon	24	17 51	☽ Moon's First Quarter			6 59·3
Tues	25					7 59·6
Wed	26					9 1·2
Thur	27	1 4	Conjunction of Venus and *τ* Leonis (2·0m.), E.			10 1·9
Fri	28			1st Tr. I.	14 47	10 59·9
Sat	29	2 20	Conjunction of Moon and Saturn, 1° 4′ N.	1st Oc. R.	14 27	11 54·3
		8 24	Near approach of B.A.C. 6369 (6)			
						Saturn
Sun	30					9 46·8
Mon	31	9 16	○ Full Moon			9 42·7
		16 2	Near approach of *χ* Capricorni (6)			
AUGUST. Tues	1	18 37	Conjunction of Mars and *h* Virginis (1·0m.) E.	2nd Sh. I.	16 17	9 38·5

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1871.

Ormersher, H.

To Sept., 1871.

Blacklock, A. W.
Cook, James.
Glover, E.
Ingram, Rev. H.
Metcalf, Rev. W. R.
Wright, W. H.

To Dec. 1871.

Herschel, Capt. J.
Hibbert, G.
Jefferies, J.
Johnson, Rev. S. J.
Squire, H.
Shawcross, W.
Stothard, Dr.

To March, 1872.

Herschel, Prof. A. S.

June 24, 1871. Subscriptions after this date in our next.

Instruments, &c., For Sale or Wanted.

These Notices, which must in all cases be paid for in advance, are inserted at the rate of *One Shilling* for *Twenty Words* or under; half-price only will be charged upon repetition, if no alteration is required. When the address is not given, application may be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—The Notice will be withdrawn should the payment not be renewed.

TO CORRESPONDENTS.

THE INDEX AND TITLE to the last Volume of the *Register* is, we regret to say, not yet ready, but we hope will soon be completed; due notice will be given to Subscribers.

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The Astronomical Register.

No. 103. JULY. 1871.

GREENWICH OBSERVATORY.

The annual visitation of this establishment took place on the 3rd of June, and, as usual, the day being fine, a large and distinguished party assembled, to see the instruments and talk over the science topics of the day. It is well said that these meetings are in effect astronomical *conversazioni*. Some join them to see people; others, to see things. The whole of the instrument rooms are thrown open; all is put in exhibition order. There is a great deal to be looked at; and he who looks carefully and gives any attention to the report of the year's labours, which at the close of the day is put into his hands, will come to the conclusion that there are few Government establishments out of which such a mass of earnest and valuable work is wrought in return for a sum so mean as that which appears in the Navy Estimates as the portion voted to the Greenwich Observatory.

In regard to the instruments, the Astronomer Royal reports that:—

"The transit circle is now in perfect working order; the object-glass was cleaned in January by Mr. Simms. Some difficulty having been experienced in the use of the finder, owing to the want of illumination of the field, a reflector has been added, which, by giving a distinct view of the wires, has proved of great use in cases where the circle had to be read off before the time of transit. The correction for level-error in this instrument having become inconveniently large, owing apparently to a gradual subsidence of the eastern support since the erection of the instrument, about a ton weight of stone was placed on the pier in August last. Not the slightest change, however, could be traced as due to this; the level-error maintaining its usual value. This plan having failed, the stones were removed on November 19, and a sheet of very thin paper, $\frac{1}{310}$ inch in thickness, was placed under the eastern Y, which was raised from its bed for the purpose. The collimators having been observed just before this operation, no difficulty was experienced in adjusting the instrument so as to have very nearly the same error of azimuth as before. The mean value of the level-error appears to be non-sensibly zero. Two of the vertical wires having been found broken, Mr. W. Simms replaced them on January 18, and at the same time inserted a new horizontal wire, so as to reduce the inclination, which for the old wire was rather large. A re-determination of the astronomical flexure of the telescope-tube, in the early part of this year, from two sets of measures made at widely different temperatures, leads to a result differing by 0·25″ from that previously found. The individual results are so accordant that I have thought myself justified in adopting this value for use in the present year. In April an examination of the form of the pivots was made, which seems to show there is no sensible deviation from circularity. As to the altazimuth, it is in good order. On January 20, 1871, the insulation of all the galvanic parts was renewed by Mr. Simms, using ebonite instead of gutta percha; the registering apparatus is now in better order than ever before. At the same time a new system of wires was inserted in the field of view of the telescope, having the middle interval larger than others, for convenience of identification on the chronograph sheet. The object-glass was taken out and cleaned on May 3. No alteration has been made in the levels, the artist apparently having been unable to perfect the construction to which I alluded in the last report. Gas-burners are fixed for illumination of the microscopes of the horizontal circle. The new water-telescope, already described in the *Register*, has been got in working order, and performs most satisfactorily. There are some interesting observations with regard to chronometer communications of time, etc., which are worthy of record in our columns. There are at the present time 202 chronometers in the chronometer room; of which 123 box-chronometers, 21 pocket-chronometers, and 13 deck-watches are the property of the Government; 1, belonging to an officer of the Navy, is on trial for purchase; and 44 are placed here by chronometer-makers to take part in the annual trial. The chronometers are compared with a mean solar clock—some every day, some every week, sometimes in high temperatures, and sometimes in different magnetic positions, as usual. Though the average of the trial numbers for the first six chronometers, in the last competition, shows a slight falling off in their merits, as compared with the preceding year, one of the number was of unusual excellence. The performance of chronometers, as depending on their mechanical construction, is very admirable. I have remarked but one point in which I could desire change—namely, that the balance should be struck more lightly, at a greater distance from its axis. The late Mr. Charles Frodsham, at my suggestion, had made some experiments on this point which promised to be successful. The principal errors, of even moderately good chronometers, are, however, produced by defective compensation, which the most skilful maker cannot perfectly manage. I have long been of opinion that the final adjustment for compensation ought to be made by some more delicate operation than that which suffices for approximate compensation; but the able chronometer-makers whom I have consulted have not yet devised a satisfactory plan. Allusion was made in the last report to a plan for securing the balance of a chronometer from injury in its transit by rail or otherwise. Nothing quite satisfactory has yet been proposed by any of the chronometer-makers who have turned their attention to this subject. Chronometers have been selected, as usual, for purchase by the Admiralty, and occasionally for foreign men of science. With regard to the personal establishment, the Astronomer Royal is responsible to the Government and the public for all transactions within the Observatory; the repairs and extension of buildings; the care of the property of the Observatory; the daily discipline, the planning of the instruments, observations, calculations, and publications are under his superintendence. The office of Chief Assistant was held by Mr. Stone till the summer of 1870, when he was appointed to the charge of the Cape Observatory. He was succeeded in this Observatory, in the autumn, by Mr. William Henry Mahony Christie, Fellow of Trinity College, Cambridge. Mr. Glaisher superintends the Magnetical and Meteorological department; Mr. Dunkin now controls the staff of supernumerary computers in the Astronomical Department; and, as senior assistant, is relieved as much as possible from severe observations. Mr. Ellis takes charge of the Time Department (chronometers and galvanic communications); Mr. Criswick, of the Circle Reductions; Mr. Lynn, of the Altazimuth; Mr. Carpenter, of the Equatoreals, the arrangement and safety of the Library and MSS., and the distribution of printed works; Mr. Nash, under the direction of Mr. Glaisher, is engaged with work incidental to the Magnetic and Meteorological department. These gentlemen are considered as permanent assistants, borne by name on the books of the Admiralty. From a sum of money placed at my disposal by the Admiralty, stipends are provided for six supernumerary computers in the Astronomical Department (increased to seven during the absence of Mr. Carpenter at Oran, for observation of the total eclipse of December 22, 1870), and for three in the Magnetic and Meteorological Department; and by these (who for the most part are very young men) a large proportion of the daily work of calculation is performed." The Astronomer Royal adds:—"I cannot speak too highly of the zealous and orderly conduct of the assistants generally.

"The occurrence of the total eclipse of the sun in December last, has brought much labour to the Observatory. As regards myself, the antecedent work in reference to general observers, the preparations for the Greenwich Observations, and the undertaking (which I found difficult to avoid) of some degree of superintendence of general report, have greatly occupied my time. As regards the assistants and computers, the actual observation on a complicated plan with the great equatorial (a plan for which few equatorials are sufficiently steady, but which, when properly carried out, gives a most complete solution of the geometrical problem) has required in observation and computation, a large expenditure of time. At the request of Mr. Huggins, and with the sanction of the Admiralty, Mr. Carpenter was detached to assist in observations at Oran, a valuable assistant was thus withdrawn from the routine work of the Observatory. My own time has been partly occupied in preparations for the Transit of Venus, 1874. I have taken measures for equipping each of the five stations with a transit, an altazimuth, and an equatorial of transits. I have five now, all mounted on stone piers. Of clocks to accompany them, I have two from the Royal Observatory, three new. Of altazimuths, I have one from the Royal Observatory, four new. Of equatorials, 6-inches aperture, and carried by clock-work, I have five, purchased or new. Of clocks of an inferior class, to accompany the two last classes of instruments, I can supply only one, and must procure nine. Fifteen portable observatories must be prepared, of which I shall be able to exhibit specimens to the visitors. The Royal Observatory can supply three 4-inch detached telescopes, and two more will be desirable. My preparations have respect only to eye-observation of contact of limbs. With all the liabilities and defects to which this is subject, this method possesses the inestimable advantage of placing no reliance on instrumental scales. I hope that the error of observation may not exceed four seconds of time, corresponding to about 0·13″ of arc. I shall be very glad to see in a detailed form a plan for making the proper measures by heliometric or photographic apparatus, and should take great interest in combining these with the eye-observations, if any selected stations can be made available. But my present impression is one of doubt on the certainty of equality of parts in the scale employed. An error depending on this cause could not be diminished by any repetition of observations. As in the event of any national enterprise being promoted in the direction of photographic record, it is probable that the Astronomer Royal may ministerially take an important part, I venture to submit to the Board of Visitors that suggestions on the value and plan of such observations fall entirely within their competence. Several gentlemen of the corps of Royal Artillery have expressed their wish to take part in the observations of the Transit of Venus, and I proposed to give them opportunities of making adjustments, etc., of instruments, in the same manner as in the actual observations. I trust they will be joined by officers of the Royal Navy."

In concluding the report, the Astronomer Royal adds, that "The catalogue of stars from Bradley's old observations is now drawn out in manuscript, and is in his hands for examination and final decision upon the use to be made of it." He also makes the following general remarks: "I have adverted in my last report to the advantage that might be obtained if the attention of the chief of the Observatory could be in some measure withdrawn from the routine and manual labour of the office, and could be allowed to expand itself more freely in the direction of physical investigations, and, perhaps, of scientific literature; although the time is far advanced, I do not abandon all hope of making some progress in these subjects. This will, however, imply the delegation (under instructions) of much work which I have been accustomed to do myself; and that change will be felt in all employments, down to those of the youngest computer. In the ordinary conduct of an Observatory of this class, as applying both to its scientific observations and to its civil services, there is little difficulty (although much labour) in maintaining general regularity. As illustrating this, I may remark, that the current reductions of observations, in spite of formation of seven-year catalogue, solar eclipses, and preparations for Transit of Venus, are in as healthy a state as they have ever been in, and these regular reductions give, in general, great facility for the most advanced inferences; the star catalogues, and solar, lunar, and planetary errors, lend themselves immediately to investigations of a physical character; the magnetic reductions distinctly, though tacitly, exhibit some of those results (for instance, annûlar irregularities) which in various observatories have been the subject of special memoirs. But from time to time it becomes desirable to unite some of those annual, or nearly annual results in groups, so as to exhibit the results justly derivable from masses of observations extending over long periods of years. These operations require new organisations, and, what is worse, they require additional grants of money. I have usually refrained from asking for these without the distinct approval of the Visitors. I would now submit for their judgment the following subjects:—

"The vigorous prosecution of the meteorological reductions (exhibiting the results reducible from the photographic registers) already begun. The combination of the results of magnetic observations on undisturbed days, from the year 1864. The discussion of magnetic storms, from the year 1858. Perhaps also the discussion of observations in groups depending on lunar declination, or other phases. There is another consideration which very often presents itself to my mind: the waste of labour in the repetition of observations at different observatories. The actual Greenwich system was established when there was little to compete with it; other observatories have since arisen, equipped with and principally using the same classes of instruments, and devoting themselves in great measure to the same subjects of observation (except the unrelenting pursuit of the moon, and perhaps the fundamental elements of the Ecliptic), ought this Observatory to retire from the competition? I think not, believing that there is greater security here than anywhere else for the unbroken continuity of system, which gives the principal value to series of observations. Still, I remark, that much labour is wasted, and that, on one side or another, that consideration ought not to be put out of sight in planning the courses of different observatories."

The *Daily Telegraph*, at the end of an able article upon the Visitation, says, with respect to the coming Transit of Venus—

"There were the important preparations for the Transit of Venus over the sun's disc in 1874. This rare phenomena offers an opportunity of determining a most fundamental astronomical datum—the distance of the sun; and the astronomers of all nations are making preparations for its observation. England is taking the lead, thanks to the energetic foresight of the Astronomer Royal, who formed his plans two or three years ago, decided upon the stations, five in number, to be occupied by British observers, obtained the Treasury authority for the expenditure of 10,000*l.* upon the observations, secured a portion of the grant for immediate disbursement, and forthwith began to purchase and plan the requisite instruments. Each station will have three observatories: one containing an equatorial of 6-inches aperture, another a transit of 4-inches aperture, the third an altitude instrument. The last two will be for determining the latitude and longitude of the station, and for obtaining accurate time: the first will be used for observing the phenomenon. Clocks and smaller telescopes will complete the equipment of each station. On Saturday specimens of each instrument were shown, the transit and altitude instruments being mounted in their portable observatories ready for the practice of those who will make the observations. We believe the observers will be scientific officers of the army and navy, several of whom have already volunteered their services. The five British stations at present selected are Alexandria, Honolulu, Roderiguez Island, Auckland, and Kerguelen's Island.

"After the deliberations of the Board of Visitors, a large section of the party, following a good custom, betook themselves to the 'Ship,' for gastronomical pleasures."

We understand that the Visitors of the Royal Greenwich Observatory have decided to recommend the Government that photography should be used in the coming Transit of Venus, and that they will advise that 5,000*l.* should be voted for the purpose.

ROYAL ASTRONOMICAL SOCIETY.

Session 1870-71.

Eighth Meeting, June 9th, 1871.

W. Lassell, Esq., F.R.S., *President*, in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The President read to the meeting a letter from Lady Herschel, acknowledging the address of condolence and sympathy passed by the Council, and reported in our last number.

The minutes of the last meeting were read and confirmed.

Thirty-seven presents were announced, and the thanks of the meeting given to the respective donors. Attention was particularly directed to a *Memoir of the Indian Surveys*, by Mr. Clement Markham, giving a most interesting account of the progress of those operations, and to a series of photographs of the last solar eclipse, taken at Cambridge, by Professor Selwyn, in which the exquisite definition of the solar spots and faculæ was very remarkable.

John Brett, Esq ,
Rev. A. Robertson, and
Rev. Reginald F. Dale,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read :—

Observations of Winnecke's Comet: by the Rev. S. J. Perry.

The occurrence of bad weather had prevented observations of this comet until it was so near the sun as to be very indistinct, although it was still more conspicuous than the comets of 1870. The star ι Aurigæ had been selected as the star of comparison, but on some occasions an intermediate double star had been used, to diminish the chances of error.

The observations of May 8, 9, and 10 were given in detail. Those of May 11 and 12 were unsatisfactory, on accouut of clouds and the object being near the horizon.

Occultation of 80 *Virginis by the Moon, on May* 30: by Capt. Noble.

The star disappeared instantaneously at the moon's dark limb, at 14h. 25m. 5s. L. S. T. = 9h. 53m. 13·9s. L. M. T., and reappeared at the bright limb from behind a dome-shaped mountain at 15h. 14m. 48s. L. S. T. = 10h. 42m. 48·8s. L. M. T. The times are good, though the atmosphere was unsteady. Power 255 on 4·2 inch equatorial.

Capt. Noble added, orally, that he wished to draw attention to the fact, that the star emerging from behind the projecting mountain was a fraction of a second later than it would have been from the uniform outline of the limb, and that an observer at a distance might have escaped this through parallax, introducing a possible element of error in a calculation of longitude.

Mr. Dunkin pointed out that had the star appeared at the bottom of a depression, the reappearance would have been accelerated.

The Astronomer Royal said, the same thing happened at eclipses of the sun, and he remembered that in 1851 the mountains of the moon reached the sun's limb as much as three seconds of time before it was entirely shut out at the bottom of cavities, and that this was the cause of Baily's beads.

Professor Pritchard said that the curious appearances seen at such phenomena were strictly speaking the result of an effect of the interference of light, sometimes called irradiation, whereby a false edge was given to any bright object to which an opaque body made an appulse. He did not think mountains and cavities entirely concerned in the question of Baily's beads. Mr. Baily himself described not only beads but black ligatures, connecting points on the sun and moon, and ending in the formation of the beads. Upon going further into the matter, references would be found to the peg-top appearances at the Transit of Venus, and if such appearances were not always seen they ought to be theoretically, and would be if looked for with a small aperture and deep eyepiece; that is, the microscope with which the object-glass image is observed must be a powerful one. The appearances were perfectly consonant with the undulatory theory of light, and accounted for by physical optics. He hoped observers of the Transit would look at it for these phenomena with small apertures and deep eyepieces.

The President remarked that small aperture and high magnifying power were most unfavourable conditions for the observation of the Transit.

Professor Pritchard: But you cannot see phenomena of interference without. It is not the astronomical observation I am speaking of, but the curious effect of the appulse of two bodies of different brightness.

The President: Then this arises from imperfect vision.

Professor Pritchard: No, no. Theory says the appearances must be there. They are not subjective phenomena, but the most objective things in creation. No one knows this better than the Astronomer Royal, who has calculated all these things. Every bright object has a spurious edge.

The discussion seemed likely to continue, but it was pointed out that time was precious, and the matter hardly relevant to the paper. It was also evident that while the President was advocating large aperture, and low power, so as to see the Transit as free from optical defects as possible, Professor Pritchard was pointing out how to produce the embarrassing results in the greatest perfection purely for optical purposes.

On the Expression of Delaunay l g h, in Terms of his finally adopted Constants: by Professor Cayley.

The author gave an oral account of the object of this paper.

On the Initial Velocities of the Planets: by Mr. Abbatt.

This paper gave the initial velocities of the planets, calculated from their known elements, as compared with velocities which would have projected them in parabolas or hyperbolas, instead of their present orbits, and the results were adduced as evidences of design in the formation of the solar system. The figures given were as follows :—

Mercury	29	miles in a second	to produce	an ellipse,	40	for a parabola.
Venus	21	"	"	"	30	"
Earth	18	"	"	"	26	"
Mars	14	"	"	"	21	"
Jupiter	8	"	"	"	11	"
Saturn	5	"	"	"	8	"
Uranus	4	"	"	"	5	"
Neptune	3·3	"	"	"	4	"

The rule does not apply to the Asteroids, as the table showed. They appear to serve other purposes, and were probably introduced in a different way.

Some discussion ensued on this paper: Capt. Noble contending that as we did not and could not know the real initial velocities and circumstances of projection, such calculations were useless; and Professor Pritchard warmly defending such speculative researches as sometimes leading to important results.

On Physical Changes in Jupiter: by Mr. Ranyard.

It having been suggested that the changes recently described were due to the superior instruments now employed in the observations, and that had the planet been studied with similar telescopes formerly, the same appearances would have been seen, the author of this paper discusses the drawings of Jupiter made within the last 20 years with telescopes of large aperture, with a view to show that changes have always been remarked in the peculiar spots and markings, and that there is a connection between such appearances and the sun-spot period. The first is a drawing by Mr. Lassell, made with 2 feet of aperture (reflector) and showing white spots. This was two years after a sun-spot maximum. The next is by Dr. De la Rue, in 1856, very near a sun-spot minimum. It was made with 13 inches of aperture (reflector), and shows no traces of the *Dawes* markings or white spots. Another picture, made by Piazzi Smyth on Teneriffe, with a 7¼-inch refractor, agrees entirely with De la Rue's and has no white markings, eggs or loops. Mr. Lassell again, in 1859, approaching a spot maximum, figured the eggs and white markings, and says he had failed to see these spots for many years, but that latterly they had appeared again. In 1861, Sir W. Keith Murray contributed some very beautiful drawings with a 9-inch refractor, showing the spots and markings in question, and other observers have since seen them with apertures of 5-inches and upwards. In 1860, the Report of the Greenwich Observatory states that with the great Equatorial, Jupiter presented appearances not previously recorded, and that Mr. Carpenter had made a series of careful drawings of the planet. The author stated that Mr. Carpenter mentioned to him that Sir W. K. Murray's drawings were almost identical with Mr. C.'s, and showed the same floculent portholes, elliptic markings and colour of the central band. At the next sun-spot minimum in 1866, there are not many drawings, and none of them remarkable, but the markings have now reappeared. If the earth were viewed from a distance, at our sun-spot maximum, the auroras then most prevalent might give a perceptible tint to parts, but they would be near the Poles. There might be similar phenomena producing equatorial changes on Jupiter.

On a New Solar Eyepiece: by Mr. Browning.

The instrument, which was described by Mr. Browning, had been introduced to his notice by Mr. Ranyard, and had been contrived by Professor Pickering. Mr. B. was so pleased with it that he made a rather imperfect one, which he exhibited to the meeting. It consisted of two prisms cemented together at their hypothenuses, and most of the light falling on this was transmitted, but enough was reflected to pass through the ordinary Huyghenian eyepiece, and being also polarized, a Nicol's prism was mounted as an analyser, and being turned round admitted just as much light as was desirable. With the light shut off, faculæ were seen bright on a dark ground, while on a spot, by admitting a little more light, the detail could be admirably studied. Of all solar eyepieces, Mr. Browning had found it the most agreeable in use.

On the Total Solar Eclipse of December, 1871, *on the Australian Continent*: by Mr. Hind.

The author finds that the duration of the eclipse will be much longer on the northern coast of Australia than in India, the totality exceeding four minutes in most places, as compared with two minutes in Southern India. He has selected five stations, and calculated the times and totality. The places are Vansittart Bay (S. extremity), Mount Casuarina, Pearce Point, Groot Eylandt (S.E. extremity), and Cape Sidmouth. These places are not colonised, but it may be desirable to send observers from Sydney or Melbourne.

On Auroral and other faint Spectra under small Dispersion: by Professor Piazzi Smyth.

The meeting was then made *special*, to consider the following proposed new bye-law:—

In Section XVI. add—

"75* Notwithstanding the preceding bye-laws, in cases where two or more persons have been jointly concerned in the production of any scientific treatise, or the carrying out of any research, work, or discovery, or have been the simultaneous but independent authors of any such treatise, work, research, or discovery, the Council may, under these circumstances, receive the nomination of such two or more persons as joint recipients of the Medal, and proceed thereupon in like manner as above-mentioned with respect to the names of separate persons; and should the Medal be ultimately awarded to such joint authors, workers, or discoverers, an impression of the Medal shall be provided for and given to each of such joint recipients."

The adoption of the new bye-law was moved by Professor Pritchard and seconded by Dr. De la Rue. They explained that it was intended to meet the case of conjoint work, like that of Huggins and Miller, or Lockyer and Frankland, on the one hand, and independent discoveries like those of Le Verrier and Adams, or Jansen and Lockyer, on the other, which at present could not be legally rewarded with the Medal.

The Astronomer Royal and Mr. Vignolles having addressed the meeting in support of the motion, it was carried *nem. con.*

The meeting then adjourned.

The Sheepshank's Astronomical Exhibition at Trinity College, Cambridge, has been awarded to Horace Lamb, scholar of the College. The exhibition is open to all members of the university, the only condition being that the person elected shall become a member of Trinity College.—*Nature*.

Our readers will be sorry to hear that the Paris Observatory has suffered much from the miserable revolution. According to M. Marie-Davy and M. de Launay, it seems to owe its partial preservation to no good feeling on the part of the Commune, who contemplated its entire destruction.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MR. NEWALL'S GREAT REFRACTOR.

Sir,—I had for some years intended to send my 25-inch telescope, when finished, to Madeira, for the sake of a better atmosphere and a more southern latitude; but as the completion of it has been delayed so much longer than I ever anticipated, I have now decided to keep it in England, and as the smoky atmosphere of Gateshead is not fit for astronomical work, I now think of removing it to the South of England.

I should like to take the advice of astronomers who live in the south as to the best locality, and will feel much obliged by communications on the subject. I imagine that some of the high ground in Surrey or Kent would be the best.

I am glad to say that Messrs. Cooke have at last finished graduating the circles, and the eye end is promised next week. The micrometers and illumination will, I hope, be completed without much further delay, and then we may look for some good results; but eight years is a long time to wait for this, which ought easily to have been accomplished in a much shorter time.

I am, sir, yours truly,
R. S. NEWALL.

Ferndene, Gateshead: 20th June, 1871.

DESIDERATA.

Sir,—May I be allowed to jot down a few things for which I conceive a need to exist, and the mention of which may possibly cause such need to be supplied?

Imprimis, then, in these days of five pound telescopes and five pound microscopes, I do not see why a five pound sidereal clock should not be produced. The face should, of course, be divided round the whole twenty-four hours, and the pendulum (which might consist of a deal rod with leaden bob for compensation) beat seconds. The train of wheelwork being the only really important part of the affair, it would matter literally nothing how common and plain the case was. An equatorial is, to a great extent, useless in the absence of correct local time; and it seems to me that a large number of the possessors of the cheaper forms of telescope now so common, who would shrink from the cost of a regular astronomical clock, would gladly avail themselves of one at the price which I suggest, and for which, I have no reason to doubt, a fairly trustworthy timekeeper might be produced.

And in the second place. As a clock is itself largely dependent in its usefulness upon the possession by its owner of some independent method of obtaining the real time, I would ask why we should not have a five pound transit too? Here again elaborate contrivance and high mechanical finish would be wholly out of place; and an instrument which would be capable of indicating the meridian passage of a celestial body within a second of the truth, would be invaluable to a very considerable proportion of incipient amateur astronomers.

Thirdly. It seems to me that for the same sum a clock might very easily be devised and constructed to chime any equatorial up to three or four inches of aperture. This, however, comes somewhat within the category of luxuries, although it is one which no one who has once experienced the ease and comfort of regarding an apparently immovable star or planet in a fixed sky, would willingly forego.

Then, fourthly. The capability of procuring an efficient rotating dome for five pounds would enable many an owner of a moderately sized telescope, to convert an existing summer-house or analogous out-door building into an efficient observatory. Can nothing be done with wood-work and canvas in this direction?

So much for my suggestions to three separate classes of artists as to a mode in which they might legitimately meet the desire of the incipient astronomer to spend twenty pounds. My next shall take the form of a query. It is this: Is the Reverend Professor Pritchard ever going to favour the mathematico-mechanical world with his tables for the calculations of the curves for achromatic object-glasses? We have been promised these tables for—I am afraid to say how long. "The cry is still, they come!"—only they do not.

Lastly. I see by this month's *Astronomical Register*, that a discussion took place at the May Meeting of the Royal Astronomical Society on the subject of the tables of Uranus, and those of the phenomena of Jupiter's Satellites, published in the *Nautical Almanac*, in the course of which it was quietly admitted that the ephemerides of that planet and of those moons were computed from tables formed in 1821 and 1836 respectively, and which are confessedly grossly inaccurate. Now, I should really like to know whether the duties of the superintendent of the *Nautical Almanac* are confined to seeing that the subordinate computers, merely do not take out the wrong logarithms, and to using data which he knows perfectly are absolutely untrustworthy, or whether they might not also be held to include an obligation to provide proper materials for the actual calculators under him to work with? It is pretty obvious that Greenwich Observatory repudiates all responsibility in this matter; and so we go on, year after year hanging out, so to speak, false lights and signals. I will never believe that the Admiralty would decline to grant the necessary pecuniary assistance to perfect a work of such national (in fact, almost mundane) importance as the *Nautical Almanac*, and can only come to the conclusion that it is pleasanter for the executive *stare super vias antiquas*, and to go on in the old jog-trot way, than to take the amount of trouble needful to remove such a discreditable blot from a book, which it ought to be their pride, no less than their duty, to make perfect.

I am, Sir, obediently yours,

June 15, 1871. EGENS.

Astronomy Simplified for General Reading; with numerous New Explanations and Discoveries in Spectrum Analysis. By J. A. S. Rollwyn.

If a pretty external covering, pretty illustrations in glowing colours, with a striking passage here and there, can simplify such a science as astronomy, we have all the elements of simplification in the work before us. Our knowledge of the science, however, leads us to expect that for attaining this object, which we apprehend is by no means a desideratum, method in exhibiting facts, and clearness in explaining theories, with illustrations which give as closely as may be the appearances of the objects represented, are essential to enable a reader unacquainted with the leading features of astronomy to perceive them as he peruses page after page, and to grasp their relations as he digests the mental food served up to him.

The illustrations, with very few exceptions, are scarcely calculated to convey correct impressions of the objects intended; inasmuch as the delicate softness of the nebulæ, for example, can only with great difficulty be reproduced in an engraving, and the dark ground ought certainly to be the colour of the sky. Green, brown, blue, as that of the sky when the sun shines strongly, are not suitable for such objects as nebulæ, nevertheless they make a pretty book, and many people like pretty pictures.

We should be glad if the illustrations were the only portions of the book on which there was the least possibility for animadversion. We do not remember to have noticed any work in which the subject of "Solar Combustion" has been seriously treated. Is the idea new? or is there any foundation for it? "The sun," says the author, "exhibits every characteristic and evidence of a body enveloped in an atmosphere of flame, the lower part of his atmosphere being comparatively dark, coinciding with that portion of the flame of an ordinary candle or other body under combustion, intervening between the brightest portion of the flame and the wick. Then comes the brightest portion of the flame, or region of white light, called the photosphere; and above that a region in which coloured flame or light is sometimes manifested * * * which last region is called the chromosphere." If the sun be the candle of the Solar system, what becomes of the products of combustion? Mr. Rollwyn supposes the solar surface to be devoid of water—we certainly have no evidence that water exists on the sun—and he further supposes that the small proportion of hydrogen which the sun possesses, floats in the chromosphere above the region of white light and intense conflagration. Smoke being heavier than hydrogen will not, according to our author, "rise higher than the prominences, but descend through the photosphere to the level of its own weight, whereby darkening the lower stratum of the sun's atmosphere; and it is difficult," our author remarks, "to say whether the rents in the photosphere do reveal to us the nucleus of the sun, or merely a dense under stratum of smoke interposed between the nucleus and the photosphere." Perhaps our readers will be inclined to regard Mr. Rollwyn's sun as a smoke-consuming furnace; his remark on the basis of his view is important. "They are not based," he says, "on the still questioned authority of astronomically applied spectrum analysis, but rather on well-established terrestrial chemical analogy, which the solar spectrum in one particular remarkably confirms, that of the composition of the sun's chromosphere." Yet in the previous sentence we find him saying, "so completely do new chemical conditions alter the whole aspect of things, and involve totally different consequences." This is simplifying astronomy.

Our space will not allow us to notice all the extraordinary statements we find in this work. We may, however, remark that the author inclines to the certainty of the existence of the hypothetical planet Vulcan and of the satellite of Venus, in opposition to his own statement that, "Science can never be said in itself to sanction that which it has not absolutely ascertained." We know that much doubt hangs over both these subjects; indeed, it is questionable if in either case the *same body*—the supposed planet or the supposed satellite—was observed, otherwise we might expect that consistent orbits would have been computed. The author denies the cosmical origin of meteors and meteor streams, referring the *locus* of production to the terrestrial atmosphere; he means terrestrial chemistry. "This," he says, "is definite and appreciable ground on which science cannot err, but may safely stand upright on the basis of demonstration."

The endeavour to simplify science by controverting theories which enable us to feel our way through such intricacies as have beset our path in the interplanetary spaces, where we have become acquainted with the existence of a large number of small planets, and with the connection of cometic orbits and meteor streams is, in our opinion, abortive. It is true the author substitutes something else; but the conflict which arises from opposite statements tends to confuse rather than simplify; and such is the general nature of the author's views that we do not consider he has produced a work which answers to its title—"Astronomy Simplified."

OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS TO MAY 31.

The Sun.—Mr. T. W. Backhouse, of Sunderland, writes that "On March 20th, at 21h. 30m., a spot in the sun's south hemisphere had an umbra 19,000 miles long, but its greatest width was but 3,500 miles. The spot passed the centre of the sun on the 21st. On the 22nd, at 3h., there was a curious curve of numerous small spots starting from it. An extensive group which passed W. of the sun's centre on the 23rd, contained on the 27th, at 5h., the largest spot then on the sun. Its penumbra was 29,000 miles in diameter, and its umbra 14,000 miles long; yet, if it existed at all on the 24th, at 21h., it must have been quite small. A spot in the sun's southern hemisphere, which passed the middle of the sun on April 11, and which was not large on the 6th, on the 7th, at 21h. 35m., had a penumbra 63,000 miles long. On the 9th, at 21h. 15m., it was about 41,000 miles long, and its chief umbra 13,000 miles in diameter, and mostly of a light shade. On April 20, at 21h. 45m., a spot, also in the south zone, had an umbra 25,000 miles long, but its *f* part was very narrow; its *p* part was very irregular. Its *f* part became broader, and on the 24th, at 20h., was separated from the *p* part. The umbra had previously shortened, being only about 21,000 miles long on the 23rd, at 21h. On the 23rd it passed the sun's centre. On the 28th, at 3h. 20m., the penumbra was 38,000 miles long. At that time there was another large solar spot, also in the south zone, which had a penumbra 33,000 miles in diameter then; but on May 4, at 5h. 15m., it was 43,000 miles long and 35,000 miles wide, and it is now (May 8) larger still. Its umbra was roundish and much mottled; and on May 4, at 4h., was 17,000 miles long and 14,500 wide. On the 5th, at 21h., however, there was a very slender bridge of light across it towards the south part, and another north, two-thirds across it. The latter still remained on May 8, 3h. 30m., and nearly cut the umbra in two; but the former had disappeared." Mr. Albert P. Holden, of London, reports as follows:—"April 10, 1871. A large spot surrounded by an extensive penumbra has recently appeared, which I observed at 2h. this day. The chief spot was rather long and narrow, except at one end, which was considerably wider, and the narrow portion was crossed by three complete (and one partial) bridges. The penumbra was unusually pale, and the umbra of a decidedly light brown hue. In the upper part of the broad portion of the umbra was a large nucleus intensely black, and so large and dark as to be visible with a very low power. Almost joining the 'yawning gulf' of the nucleus was a light, triangular patch, not quite so light as the penumbra. From the great ease with which the nuclei have been seen on this and other occasions, it would seem as if they increased in visibility with the approach of the maxima of sun-spot period. When they are visible, as on the present occasion, the umbra and penumbra of the spot in which they occur are always unusually high in colour." Mr. William F. Denning, of Bristol, observed the sun with his 10¼-in. and 4-in. reflectors on May 26; but, with the exception of a large scattered group, the spots were neither large nor interesting.

Jupiter.—Mr. Albert P. Holden says:—"On February 20, at 7h. 30m., I observed the planet, and found the usual equatorial belts to present a most remarkable appearance. The whole equator was covered by what appeared to be great masses of clouds stretching across the planet in four parallel but rather irregular rows, each row containing about four or five distinct masses of cloud. As I was using a diagonal eyepiece, I thought at first the mirror had become covered with moisture, but found the phenomenon to really be on the planet's surface. With a low power the whole equator had a mottled appearance, but higher powers brought out the mass of cloud very distinctly. Clouds coming over prevented my observing whether or not the rotation of the planet would change the scenery of the disc at all." Mr. Edmund Neison, of London, writes, with regard to this planet:—"The only result worth mentioning is the gradual deepening of the tinge of the equatorial belt, and the increase in the general orange tinge of the whole disc. In fact, on May 15 it appeared to have changed to a distinct red. This is probably due merely to the low altitude of the planet and its immersion in the orange mists of sub-sunset."

Mars.—Mr. Albert P. Holden, with his 3-in. refractor, has obtained some very good views of this planet. He writes:—"The Kaiser Sea and Dawes Ocean come out very distinctly. This planet seems to bear magnifying much more readily than other objects; 80 to the inch of aperture giving most excellent views."

Recent Occultations of Uranus.—On page 131 of the *Register* for June, there is an enquiry as to when the last Occultation of Uranus took place. On searching, I cannot find mention made of any since 25th August, 1839, when the planet disappeared at 8h. 45m. and reappeared at 9h. 17m. It would be interesting to know how far the tables were in error thirty-two years back. Can any of your readers give information on this point? At the Occultation of February last the sky was here cloudy. On the morning of March 3 it was bright, but I missed the disappearance of the planet for the same reason as others.

Upton Helions Rectory, Devon. S. J. JOHNSON.

The Planet Amalthea.—The following elements of the new Planet Amalthea (113) have been published by M. Oppolzer, of Vienna:—

Epoch: 1871. March 13.

		°	′
Mean Longitude	=	178	51
Mean Anomaly	=	339	36
Longitude of Perihelion ...	=	199	15
Longitude of Ascending Node	=	123	4
Inclination	=	5	2
Angle of Eccentricity ...	=	4	55
Mean Daily Motion ...	=		968″
Log. Mean Distance ...	=	0·375,895	

OBSERVATIONS FOR JULY, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, midnight		60°N.		0°		60°S.
			SUNRISE.			
		°		°		°
1871. July 1	...	−81·6	...	−81·1	...	−80·7
			SUNSET.			
2	...	+87·2	...	+86·7	...	+86 2
3	...	75·0	...	74·5	...	74·0
4	...	62·9	...	62·3	...	61·7
5	...	50·7	...	50·1	...	49·5
6	...	38·6	...	37·9	...	37·2
7	...	26·4	...	25·7	...	25·0
8	...	14·2	...	13·5	...	12·7
9	...	+2·1	...	+1·3	...	+0·5
10	...	−10·1	...	11·0	...	−11·3
11	...	22·3	...	23·2	...	24·1
12	...	34·5	...	35·5	...	36·4
13	...	46·7	...	47·7	...	48·7
14	...	58·9	...	59·9	...	60·9
15	...	71·1	...	72·2	...	73·2
16	...	−83·3	...	−84·4	...	−85·5
			SUNRISE.			
18	...	+69·9	...	+71·1	...	+72·2
19	...	57·6	...	58·8	...	60·0
20	...	45·3	...	46·6	...	47·8
21	...	33·0	...	34·3	...	35·6
22	...	20·7	...	22·1	...	23·4
23	...	+8·5	...	+9·9	...	+11·2
24	...	−3·8	...	−2·4	...	−1·0
25	...	16·1	...	14·6	...	13·1
26	...	28·3	...	26·8	...	25·3
27	...	40·5	...	39·0	...	37·5
28	...	52 8	...	51·2	...	49·6
29	...	65·0	...	63·4	...	61·8
30	...	−77·2	...	−75·6	...	−73·9

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN JULY, 1871.

BY W. R. BIRT, F.R.A.S.

Day.		Supplement ☾ — ⊙ Midnight. ° ′		Objects to be observed.
20	...	142 24·8	...	Mare Crisium, E border, with the two promontories at the "Pass."
21	...	130 28·3	...	Guttemberg (*a*), Navigators' Nook (*b*).
22	.	118 17·3	...	Central Mountain of Theophilus (*c*).
23	...	105 50·9	...	Sabine, Ritter, Gwilt Brothers (*d*).

The Astronomical Register.

No. 104. AUGUST. 1871.

ANCIENT ECLIPSES.

In previous Numbers of the *Register* mention has been made of ancient eclipses: No. 51, page 71; No. 63, page 70; No. 100, page 98. It might gratify some readers to mention a few more. In Ingram's translation of the "Saxon Chronicle" (Longmans, 1823), several old eclipses are spoken of. I have here selected what seem to be some of the more interesting of them. The results of the computations I have made about them are given below, as I have never seen mention made of any of them except the last.

A.D. 733. "This year Ethelbald took Somerton? the Sun was eclipsed, and Acca was driven from his bishopric." The eclipse must have been on August 14, when I find a very large one took place, but not total, the Moon's semidiameter being 15′ 22,″ the Sun's 15′ 54.″ It seems to have been annular at London at ¼ past 7 that morning.

A.D. 827. "This year was the Moon eclipsed on midwinter's mass night." The eclipse of December 25, 828, must be here meant. It began a few minutes after the previous midnight, was total for 1¼h., and ended a few minutes before 4.

A.D. 1110. "The king held his court this year for the first time in New Windsor. On the 5th night in the month of May appeared the Moon shining bright in the evening, and afterward by little and little its light diminished, so that as soon as night came on it was so completely extinguished withal, that neither light, nor orb, nor anything of it was seen. And so it continued nearly until day, and then appeared shining full and bright. It was this day a fortnight old. All the night was the firmament very clear, and the stars over all the heavens shining very bright, and the fruits of the trees were this night sorely nipt by the frost." I find a total eclipse of the Moon began this evening about 9h. 10m., and ended 12h. 40m. Totality lasted over 1h. 35m. From the description, "Neither light, nor orb, etc., was seen," this must surely have been one of those rare cases such as in 1642, 1761, when the Moon's disc disappeared entirely during totality, instead of appearing of the ordinary copper tint.

A.D. 1117. "In the night of the third day before the Ides of December was the Moon during a long time of the night as if covered with blood." On the night of December 9, this year, an eclipse of the Moon began about 10h. 22m., became total 11h. 22m., continued so till about 1 a.m., and ended at 2h.

A.D. 1135. "In this year went the King Henry over sea at Lammas: and the next day as he lay asleep on ship, the day darkened over all lands: and the Sun was all as it were a three-night-old Moon, and the stars about him at midday. Men said a great event would come, and the same year was the king dead, the day after S. Andrew's mass-day, in Normandy." There must be a mistake here. At the new Moon in August of this year there was no eclipse, the Moon being too far from the node. But on August 2 (the day after Lammas), 1133, an eclipse took place, which seems to answer the conditions pretty well. It amounted to more than ten digits of the Sun's disc, at London, at 11h. 5m. that morning. Thus the Sun would assume the appearance of a three-night-old Moon. Further south the eclipse would be total, and the description of the stars showing themselves must be taken from those who saw it there.

A.D. 1140. "In the Lent the Sun and the day darkened about the noontide of the day, when men were eating, and they lighted candles to eat by. That was the 13th day before the Kalends of April. Men were very much struck with wonder." Another old chronicle says this happened at the 9th hour of the day. I find a total eclipse of the Sun actually did take place on March 20, the totality being attained about 2h. 37m.

These computations were made from the Tables in the Encyclopædia Britannica, eighth edition.

S. J. JOHNSON.

Upton Helions Rectory, Devon.

The death is announced of Dr. Franz von Schaub, the astronomical computer of Vienna.

A New Comet has been discovered by M. Schiaparelli. Right ascension, July 30, 4h. 49·2m.; declination, $+59^\circ\ 25'$; motion retrograde. It is an object of extreme faintness.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MR. NEWALL'S TELESCOPE.

Sir,—As some sort of answer to Mr. Newall, I forward a list of the number of clear nights since 1858, taken from my note-book. By clear nights I mean nights clear throughout till, say, 11 p.m., or else clear for an hour or two. Formerly, I was in South Lancashire, about 12 miles from Manchester (not one of the most smoky parts); since the early part of 1870 I have been in Devonshire. The comparative number of clear nights is immensely in favour of the latter locality, though doubtless some allowance should be made for the extraordinary and long continued fine weather of last year.

In 1859,	number of nights	clear throughout	or in part	...	60
„ 1860	„	„	„	...	43
„ 1861	„	„	„	...	46
„ 1862	„	„	„	...	46
„ 1863	„	„	„	...	47
„ 1864	„	„	„	...	83
„ 1865	„	„	„	...	82
„ 1866	„	„	„	...	77
„ 1867	„	„	„	...	55
„ 1868	„	„	„	...	62
„ 1869	„	„	„	...	58
„ 1870	„	„	„	...	112
„ 1871	„	„	(first half till June 30)	...	43

Upton Helions Rectory,
Crediton, Devon.

Yours faithfully,
S. J. JOHNSON.

DESIDERATA.

Sir,—In reply to the excellent suggestive communication, under the above title, by "Egens," in this month's *Astronomical Register*, I have the pleasure to inform him that a good, sound Siderial Clock *can* be produced for £5; the pendulum beating seconds and the clock striking the seconds. The face is divided all round the twenty-four hours, and furnished with a seconds hand. The case is of pine, neatly grained and varnished. The escapement is that known as chronometer, and the pendulum, which is only ten inches in length, has its compensation effected by a tubing of zinc working on steel.

The followiug are the dimensions of the clock :—

Height of case	20 inches.
Breadth of ditto	11 „
Depth	6 „
Diameter of disc	8 „

The above clock is a first-rate timekeeper.

Mr. Cocks, of Wells-next-the-Sea, tells me he will be happy to receive the names of gentlemen requiring such clocks; and as soon as he gets a list of twenty, he will immediately put the work in hand, and deliver the clocks (*for cash*) to the subscribers, according to priority, the whole number being completed in a very few months. On receipt of twelve postage stamps, a photograph of the clock will be forwarded by Mr. Cocks to any address.

The clock may be timed most readily by Dent's Dipleidoscope, which, if correctly adjusted for the meridian, will give the time *within* a second; indeed, sufficiently accurate for most amateur purposes. This elegant little instrument costs £2 12s. 6d.

I am, Sir, yours obediently,
HABENS.

THE TABLES OF URANUS.

Sir,—In reply to Mr. Johnson, Loomis ("Treatise on Astronomy," p. 243) states that the difference between the observed place of Uranus, and that computed by Bouvard's tables (the same as now used) in 1840, was —82″, and in 1846, —128″. Grant ("History of Physical Astronomy," p. 167) states the discordance in 1838 amounted to 50″; in 1841, to 70″. Perhaps if Mr. Lynn's letter in the *Astronomical Register* three years ago (June 6, 1868, vol. 6, p. 159), had been remembered, observers would have allowed more for the errors of his tables, and not have missed the last occultation. Egens, however, is wide of the mark in his remarks on this subject. The preface to the *Nautical Almanac* gives the names of the authors of the tables used in its computations, and all that the computers can be expected to do is to take the best existing. The *improbus labor* of making new tables falls as little to their province, as it does to that of the Greenwich Observatory, the data furnished from which to Hansen enabled that eminent mathematician to bring the lunar tables to their present almost unhoped for perfection; for Euler despaired of the possibility of ever computing the moon's place nearer than 30′. Doubtless there are also many observations of Uranus available for any one possessed of sufficient ability and leisure to use them for making new tables. For much in our *Nautical Almanac* we are indebted to Leverrier, Hansen, Peters, Bouvard, Damoiseau, and Newcomb; one would wish to see more English names in this high department than those of airy, Adams, Baily, and Woolhouse, distinguished as those are. It is to be hoped that with the large number of persons who now cultivate astronomy more or less, there may be also a few whose tastes and acquirements may lead them to furnish by-and-by illustrations of Schumacher's remark (*Astronomical Register*, for June, p. 147) about the value to the science of a single exact and able calculator. We appear to want something to encourage and lead students in this direction. We have good works on descriptive and practical astronomy; but some work is needed in the way of introduction to the physical department; the calculation of planetary and cometary orbits, perturbations, and the construction of tables; of the toil and intricacy of which the non-mathematical reader may form an idea by the study of Airy's *Treatise on Gravitation*. Meanwhile, if defects in the tables of Uranus, and of Jupiter's moons (I have always found the eclipses of the first and second accurately given, and have avoided having much to say to the third and fourth), constitute, as Egens says, "a discreditable blot" on the *Nautical Almanac*, it is one, as far as I know, from which no astronomical ephemeris in existence is free.

For myself, I am more thankful for things as they are, than disposed to find fault because they are (through nobody's fault) not better. If Delambre had not been followed by Bouvard in this instance, we should have had to put up with still greater errors ; and as it is, we must only hope that they are approaching their maximum, and wait for a worthy successor to the latter.

Whether the Admiralty, as suggested by Egens, would attach importance to a question of some astronomical, but no navigational value, is, I fear, doubtful. I should place more confidence in the result of a prize offered by some learned body for a revised theory of the planet ; such as that proposed by the Academy of Sciences of Paris, and which led to the theory and tables of Delambre.

I never pay my half-a-crown for a new *Nautical Almanac* without feeling grateful to the skilful opticians and observers who made such a publication possible ; to the talented and indefatigable investigators who used so much brain-work and perseverance in obtaining formulæ, unravelling perturbations, and eliciting symmetry from the observations ; to the computers who so patiently and accurately worked up the materials thus placed at their disposal ; and to the Admiralty for selling such a book at such a price :—

"*Hic meret æra liber Sosiis ; hic et mare transit.*"

And Egens, I am sure, appreciates all this too. But he affirms that we go on hanging out "false lights" every year. Yet if I know that the lights in question indicate a shoal of shifting dimensions, or uncertain outline, I ought to make due allowances for it, and direct my course accordingly.

"*Verum ubi plura nitent in carmine, non ego paucis*
Offendar meculis,—"

especially when these maculæ are owing to no carelessness, but merely to the force of circumstances. Clouds here prevented any observation of the last occultation of Uranus. We shall all, no doubt, be more "up to" this unruly planet next time. After what Mr. Dunkin said at the May Meeting of the Royal Astronomical Society, I should certainly, includ ng the possible effect of parallax, not look for the occultation less than iten minutes before the time noted in the *Nautical Almanac;* and probably a quarter of an hour would not be too much for observers whose longitude is greater. The first part of the letter of Egens every one must go along with. We must hope it will attract attention. I have sometimes thought it might serve the interests both of opticians and their customers if instruments could be let out on hire, or paid for by instalmenst, as ladies sometimes get pianos.

The late Professor De Morgan wrote in 1836, "Nobody but a mathematician can sympathise with the director of an observatory, using all his efforts of body and mind, so to improve the lunar theory as to abolish the second of time (or thereabouts), by which she will not come on the meridian according to prediction." And he has a note of a supposed dialogue between two astronomers, not exaggerated, which is as follows :—

A. Have you seen the volume of observations for this year ?

B. No, but I am told the moon is very much out.

A. Yes; indeed, almost two seconds in one place.

B. The small planets alogether wrong, as usual, I suppose ?

A. Yes, Pallas is out nineteen seconds ! However, some of that is in the epoch.

B. I wonder whether we shall ever know anything at all about those small planets, etc. ?

"This," continues the professor, "will serve the reader to adjust his notions, when he hears, in one point of view that modern astronomy is very correct, and in another that it is all wrong. The first looks to what has been obtained, the second to what remains to be done."

The tone of quiet resignation, and patient, though but faint hope of a "better time coming," in this, rather amusingly contrasts with the somewhat excited discussion lately on the subject of Uranus. One can sympathise with the gentlemen who missed the occultation, whilst puzzled rather to conceive how any one acquainted as an F. R. A. S. might be expected to be, with the whole history of the perturbations of Uranus, leading to the astonishing discovery of Neptune, could place himself, as Captain Noble says he did, at the telescope, only two minutes before the predicted time! After so singular an amoumt of disappointed faith in this part of what has been termed the "Astronomer's Bible," the Captain seems to have rebounded into an equal degree of scepticism, and thinks the Government ought at least to give warning "their book is not to be relied upon!" This probably, on reflection, the respected Signor Capitano himself would consider somewhat too broad; and he would perhaps be content if a general allusion to the defects in the existing tables of Uranus were inserted, as has been already done in the case of Jupiter's satellites. (*Naut. Almanac*, p. 545.) This, however, could not appear till the *Nautical Almanac* of 1875, till which time may he and all of us, including the local board, and the carpenter, whose education, it appears, has been neglected, be spared. Who knows, but that before then we may see a better "direction-post" put up, and this shockingly misbehaved planet considerably reformed?

I am, Sir, yours, etc.,
GEORGE J. WALKER.

INDIAN ASTRONOMY.

The celebrated Aryabhata was born A.D. 476. Lassen calls him "the founder of mathematical and astronomical science in India;" meaning, no doubt, that he gathered up the scattered learning of preceding centuries, and infused into it the more correct views which his master-mind had received from Greek teaching. His idea of the roundness of the earth is thus expressed:—"The terrestrial globe, a compound of earth, water, fire, and air, entirely round, encompassed by a girdle (*the equator*), stands in the air, in the centre of the stellar sphere. Like as a ball formed by the blossoms of the nauclea Radamba is on every side beset with flowerets; so is the earth-globe with all creatures, terrestrial and aquatic." And this globe he believed to have a daily revolution. "Aryabhata," says Dr. Keon, "for aught we know, was the first, and remained almost the sole astronomer among his countrymen, who affirmed the daily revolution of the earth on its own axis." He gives the following quotation from one of Aryabhata's works:—"As a person in a vessel, while moving forwards, sees an immovable object moving backwards; in the same manner do the stars, however immovable, seem to move daily." On another occasion Aryabhata says: "The sphere of the stars is stationary; and the earth, making a revolution, produces the daily rising and setting of stars and planets." Mr. Colebrooke states that "Aryabhata affirmed the diurnal revolution of the earth on its axis;" that he accounted for it "by a wind or current of aerial fluid, the extent of which, according to the orbit assigned to it by him, corresponds to an elevation of little more than a hundred miles from the surface of the earth; that he possessed the true theory of the causes of lunar and solar eclipses, and disregarded the imaginary dark planets of the mythologists and astrologers, affirming the moon and primary planets (and even the stars) to be essentially dark, and only illuminated by the sun."

But after attaining this excellence, Astronomy in India appears to have drifted away from science, and writers subsequent to Aryabhata confuse astronomy with astrology.

Varâhamihèra may be cited as a celebrated astronomer, to whom astrology was irresistibly attractive (born A.D. 530).

Dr. Kern observes, that he was in "the awkward position of a man who has to reconcile the exigences of science with the decrees, deemed infallible, of the Rishis" (inspired poets of the Rigveda). Varâhamihèra is noted for using Greek terms, and for his frequent reference to Yavanas (Greeks). "Astrological prediction," observes Mr. Colebrooke, "by configuration of planets, indicates by its Indian name, Hora, a Grecian source. Of this word, Varâhamihèra has attempted a Sanskrit derivation, which is not conformable to Sanskrit etymology; whereas the Greek *hora*, and its derivative *horoscopos*, means one who considers the natal *hour*, and thence predicts events." Colebrooke gives further evidence to the same effect, and says that Varâhamihèra frequently quotes the *Yavanas* in his treatise on horoscopes, and his scholiast characterises ancient Yavanas as a race of barbarians conversant with (*hora*) horoscopes." The English translation of Varâhamihèra's System of Natural Astrology commences thus:—"Victory to the all-soul, the source of life, the inseparable ornament of heaven—the Sun, who is adorned with a crown of a thousand beams, like unto liquid gold."

Mr. S. Wilkinson for eight years had tried in vain to convince his friend, Subhaji Bâpû, of the sun's relation to the earth. Then, happening to meet with the old Hindu works, he was able to teach the same from his own acknowledged authorities, and at once conviction was carried to his mind.

Mr. Wilkinson describes Subhaji Bâpû as a man of wonderful acuteness, intelligence, and sound judgment, who was lost in admiration when he came fully to comprehend all the facts resulting from the spherical form of the earth. And when the retrogressions of the planets were shown to be so naturally accounted for on the theory of the earth's annual motion; and when he reflected on the vastly superior simplicity and credibility of the supposition that the earth had a diurnal motion, than that the sun and all the stars daily revolve about the earth, he became a zealous defender of the system of Copernicus. He then lamented that his life had been spent in maintaining foolish fancies, and spoke with bitter indignation against all those of his predecessors who had contributed to the wilful concealment of the truth that error had been acknowledged in the land.—[Related at a meeting of the Associate Society of Bengal, June 7, 1837. Letter from Mr. Wilkinson to Sir W. H. Macnaughten.]

Subhaji Bâpû has since become a distinguished astronomer and professor at the Government College of Benares.—*Ancient and Mediæval India.* By the late Mrs. Manning. Vol. I. pp. 359—378 (1869).

INSTRUMENTS FOR SALE.—One or two scarcely pardonable blunders have occurred lately in our notices of instruments for sale. These having been corrected, and the notice repeated, we need not further allude to them, except to remark that a 6-inch telescope offered for twenty pounds caused us to have to reply to a great number of letters on the subject, from those anxious to obtain a large instrument at so low a price : the error to some extent thus brought its own punishment. We may add with regard to these notices, that many have remarked that our list of instruments for sale is neither so long nor so interesting as it used to be, and have urged us to revert to the plan of inserting them gratis. We can only say that when we did so, many remained in the list long after the instruments referred to were sold, from want of information supplied to us ; and therefore the list appeared longer than it should have done. We may also say that for some time there do not appear to have been so many second-hand instruments for disposal as formerly: in fact, applications are now almost as numerous for purchase as for sale. There is no doubt that really good telescopes find a ready sale in private, and that even instruments not of the very first class can be sold if the price asked is moderate.

Hackney Scientific Association.—The Fourth Annual Meeting of this Society was held on June 6, when there was a good attendance of members. From the report read by the honorary secretary, Mr. H. W. Emons, it appeared that the Society had made good progress during the past session, the number of members having more than doubled, and the papers communicated having been unusually numerous and interesting. The more immediate contributions by the members to the progress of astronomy comprised :—"A Method for Ascertaining the Existence of Lunar Changes," by Mr. W. R. Birt, F.R.A.S., Vice-President ; "The Discovery of a New Variable Star, ϵ Hercules," by Mr. H. T. Vivian ; "A Determination of the Dimensions of the System of Algol," by Mr. A. P. Holden ; and the preparation of "A New Classified Catalogue of Variable Stars, for the use of Members." In addition to the introductory address, by Mr. W. T. Lynn, B.A., F.R.A.S , on "Recent Progress in Astronomy," papers have been read on "Comets ;" "Evidences of Recent Changes on the Moon's Surface ;" "The Physical Constitution of Variable Stars ;" "Observations on Solar Eclipses ;" and many others. Good progress had also been made with the library, which had been enriched by contributions from G. J. Walker, Esq., and other gentlemen ; also from members and several societies, to all of whom the thanks of the meeting were awarded. The officers for the next session having been elected, the meeting adjourned ; thus bringing a very successful session to a close.

ON THE STUDY OF SELENOGRAPHY.

By W. R. Birt, F.R.A.S.

The successful prosecution of the study of selenography in common with that of every other branch of science is greatly influenced by the earlier steps taken by the student. If the foundation be well laid by obtaining a systematic acquaintance with the broader and larger features of the moon's surface, the after process may be proportionally rapid. The essential requisites are telescopes, maps, and catalogues ; the first for viewing the surface, the second and third for identifying the objects seen. For *beginning* an inquiry into the aspect of the moon's surface, we should strongly recommend the employment of a *small* telescope of not more than three or four inches aperture, and for an instrument under three inches we have now before us a map $4\frac{3}{4}$ inches diameter, with 155 references, published in the *Leisure Hour*, for July 15, 1871, which is particularly suitable for a beginner.

Having directed his telescope to the moon at an early phase of the lunation, we should advise, in the *first* place, an identification of the so-called seas, maria, or grey plains, proceeding from west to east. To these there are twenty references, and the identification of them may interestingly occupy one lunation. The identification of the mountain ranges is more difficult. We should not recommend a *first* attempt in this direction until just after the moon had passed her first quarter, previous to which it would be desirable for the observer to read the article on "Mountain Scenery," in the *English Mechanic*, No. 322, May 26, 1871, p. 222. At the phase mentioned, the *Alps*, *Caucasus* and *Apennines*, may be readily identified, and a very correct notion of the appearance of lunar mountain ranges obtained. When this is accomplished, the student may proceed to identify the remaining mountain chains specified on the map referred to.

In addition to these mountain chains there are numerous isolated mountains scattered over the surface of the moon, and it is desirable that the student should be able to distinguish easily between a mountain raised above the surface, and a crater or pit sunk below it. For this purpose a study of shadow is indispensable. Shortly after new, the moon's western limb is illuminated, and *all* shadows are thrown towards the east, a mountain has therefore its western slope strongly illuminated by the rays of the rising sun, while its shadow extends on a plain or rugged surface, as the case may be, towards the east. Many of the craters are surrounded by a mountainous ring, which in like manner has its shadow thrown towards the east, generally of a triangular form, ending in a point; in addition, the shadow of the west rim is thrown *within* the crater, and takes a form dependent upon the nature of the interior, if shortly after sunrise it extends nearly as far as the eastern rim, it is convex in shape. Should the crater be shallow, the shadow soon falls upon the floor, and as it recedes from the eastern rim it is concave towards the rim; but if the crater be deep, it retains the convex form during a period proportioned to the depth. The shadows of both mountains and of craters, interior and exterior, are greatly modified by the nature of the surface on which they fall, as well as by the irregularity or smoothness of the outlines of the mountains and rims of craters. If any doubt should arise as to the true nature of an object, an examination of it under the evening light will clear up many a difficulty.

From the identification of the mountain ranges, the observer may proceed to that of the named objects, of which there are 123 specified. As the arrangement of these is, with but few exceptions, from west to east, he will find it convenient to examine them in order from evening to evening until he is fully acquainted with their leading features. It is not at all unlikely that in the course of this examination many interesting details and features that could not be specified or alluded to in a map on so small a scale may so arrest his attention that he may be desirous of possessing some references to them, and he may be disposed to postpone the general identification of objects while he studies some particular region. Now this desire should not be repressed, and in order to carry on both lines of study effectively, he should keep *two* note-books; one especially devoted to *identifications only*, in which the work of each evening, with all the necessary elements for ascertaining at the epoch of observation, the nature of the illumination and visual angle, including the day of the Julian period, should be entered: the other for extra work, as sketching and describing any particular region, the features of which the observer may be much interested with. Although he may think that while he is interested, the features sketched and described are well known to other observers; yet in this respect he may be much mistaken, for such is the state of selenography at the present epoch, that many valuable records may be absolutely lost, merely because observers have set too low a value on their observations, and have taken no steps to place them on permanent record. At some future time an observation of an object as seen at a given epoch, and duly recorded, may possess a value which the observer may never have contemplated, by setting at rest a question of change, which could not have been determined without it. In connection with these remarks it would be well if some receptacle for the preservation and consultation of selenographical observations could be established. At present the literature of this branch of science is not extensive, to increase it, especially as regards the printing of observation, would not be remunerative; to make copies of their observations would be too laborious for observers; but if their note-books, when filled, were deposited in an office for safe custody, where they might be inspected under proper regulations, we have no doubt selenography would rapidly progress.

While using the little map above referred to, the selenographical portion of the Rev. T. W. Webb's "Celestial Objects for Common Telescopes," may be perused with advantage; in it the reader will find some very interesting general remarks on lunar features, followed by short notices of those that are the more conspicuous. These notices will greatly assist the student, who we have no doubt will find much pleasure in *extending* them, not that we would intimate that the author of this most useful work has given the fullest information in his power, for we know that he could have given a far greater quantity, but the scope and aim of the work is such as to preclude the introduction of any lengthened description of even the most prominent objects. In the valuable series of papers on lunar details by the same author, in the *Intellectual Observer*, the reader will find much useful information; but even with these there is great room for adding to our knowledge. The closing portion of Mr. Webb's chapter on the moon consists of list of 426 objects, with references to his index map, which has probably been found more useful than any extant. As a new edition of the work is called for, it is the intention of the author to submit the map to a careful revision, in the course of which several objects will be inserted, doubtful portions of the map redrawn, and the nomenclature extended by including additional names.

The previous use of the *Leisure Hour* Map will have prepared the students for entering very efficiently on the examination of the moon with the aid of Mr. Webb's Map; and we would recommend precisely the same course of study, viz., the identification of objects proceeding from west to east, recording carefully in its appropriate note book each evening's work, and the extra work of examining special objects. In a future article we may probably call attention to the study of more minute detail, for which elaborate helps are needful.

Sulla Vitane Sulle Opere di Giovanni Inghirami, Memorie Storiche, da Giovanni Antonelli delle Scuole Pie, Prof. di Matematiche e di Astronomia, &c., &c. Firenze, 1854.

The family of Ingram, or Inghiram, in Italian, Inghirami, appears by a tradition preserved in it, to have been of Saxon origin, and to have removed to Italy at the time of Otho the Great (d. A.D. 973), and settled at Volterra. Ancient annals make frequent mention of its part in the factions which often occurred between different municipalities, and several of its members are found to have held high public offices. Giovanni Inghirami, son of the Cavaliere Niccolò Inghirami, was born at Volterra, on the 26th April, 1779. His brother Francesco is well known as the author of several splendid works: the *Monumenti Etruschi*, the *Galleria Omerica*, *L'Etrusco Museo Chiusino*, and *La Storia della Toscana*. He died 17th May, 1846. Giovanni Inghirami entered the order of the Poor Regular Clerks of the Scuole Pie (Pious Schools), or Calasanzian Institute, called after the meritorious Spaniard, Joseph Calasanzio, who founded it towards the close of the sixteenth century, for the gratuitous education, both religious and secular, of the youth of all classes. Inghirami devoted himself passionately to the study of physical mathematics; above all other branches to astronomy and geodesia, in which, under the famed professors, Stanislao Canovai and Gaetano del-Ricco, he soon attained to high proficiency. Become in his turn a teacher, the reputation obtained by his success in this line was increased by the academic essays which he produced at the close of the scholastic years. Besides others relating to pure mathematics and astronomy, may be mentioned those on the *Principles of Hydromechanics*, and on the *Statics of Buildings*. These works were so appreciated by his former above-mentioned masters, that they recalled Inghirami from Volterra to Florence, with the view to his ultimately succeeding them in the chairs of higher mathematics and astronomy, employing him meanwhile as instructor in elementary mathematics and physics. This arrangement was most gratifying to Inghirami, as he saw in it the means of dedicating himself fully to the science of the stars, his admiration and ardent love for which had been increased by the recent discovery of Ceres, Pallas, and Juno. But amply furnished as he found himself with the means for advancement in theoretical, he was very deficient in the appliances which are indispensable for practical astronomy.

The observatory founded at the College of S. Giovannino in Florence (which came into the possession of the fathers of the Scuole Pie), by the Sicilian abbot Leonard Ximenes, who died May 3rd, 1786, consisted only of a large hall, which contained a poor transit instrument, a rude movable quadrant, an indifferent mural quadrant, and a fair pendulum clock. A visit in 1807 to the Royal Observatory of Brera, in Milan, directed by Oriani, enlarged Inghirami's acquaintance with practical astronomy, and procured him the friendship of the well-known astronomers Carlini and Santini. His first astronomical work was the publication of an annual ephemeris of occultations of stars; the method of approximately predicting which by an ingenious graphical process, together with the requisite tables, was made public in 1826. He succeeded to the chair of higher mathematics, vacant by the death of Canovai in 1811. His admirable method of instruction, which made his lectures more like scientific and friendly conversations than magisterial lessons, was rewarded by the large number of proficient pupils which came forth from his school. In 1814, he was rejoiced at the addition to his poor observatory of two fine repeating circles by Reichenbach; the larger, eighteen inches in diameter, declared by its maker to be one of the best he ever turned out, was devoted exclusively to astronomical work; the other, eight inches diameter, was used in the survey of Tuscany. This was a work which had never as yet been properly executed, and the first accurate steps in which were made by Baron de Zach, in his visit to Florence in 1808, assisted by Inghirami. The Government consenting to bear the expense of the survey, Inghirami, notwithstanding his other onerous duties, was enabled in 1816 to lay before the public a first specimen of his labours, in a *Memoir on the Longitude and Latitude of the Cities of Pistoia and of Prato*. Various discrepancies with previous trigonometrical operations by the French led to a mistrust of the small base line, twice carefully measured by De Zach, and at length caused Inghirami to undertake, in 1817, as De Zach himself had often pressed upon him, the measurement of a new one. With the help of several able assistants, this work was completed in one month, and a base line of above five Tuscan miles measured on the fine open plain between Pisa and Livorno; an account of which was given in a very interesting and valuable memoir published in 1818. Great was the gratification of Inghirami when the length of this line concluded by two separate net works of triangles from De Zach's humble base, differed only by half a toise from the actual measurement! There still remained, however, an inexplicable variation in the latitude of Pisa, as determined geodesically and astronomically. The extension of a triangulation in N. Italy, by Brioschi to Tuscany, brought to light other notable instances both as regards longitude and latitude. A great sensation was in consequence excited amongst astronomers in Germany, France, and Italy, and De Zach, Lindenau, Carlini, and others were busied in the investigation of the subject. De Zach considered that three causes operated. 1. Errors in the instruments and observations. 2. The effect of terrestrial and local attractions on the plumb-line and levels. 3. Irregularities in the conformation of the earth. On the other hand, Baron de Lindenau attributed the discrepancies to the astronomical results, which with existing means he thought were liable at least to an uncertainty of three or four seconds of arc. An attempt to connect the observations of Milan and Florence by fire-signals on an intermediate mountain, distant from each respectively 100 and 39 miles, twice failed. The reason assigned being the prevalence of a stratum of misty air on the surface of the ground after sunset. The third time, in 1825, the signals were well observed before the break of day, and gave a result that differed only five seconds of arc from Brioschi's geodesical conclusion.

Professor Antonelli's elaborate and able discussion of the famous discrepancies above mentioned is full of interest. He gives a table of the latitudes, astronomical and geodesical, of eighteen places in Italy, showing the differences of the two ranging from one or two seconds of arc to above 15″, and in one instance above 30″: he indicates the districts in which the plumb-line is subject to the greatest and to the least deflections; and remarking that the little hills south of Florence exercise a very notable influence, attributable probably more to their greater density than to their volume; he assigns the discrepancy of 8″ encountered by Inghirami between Pisa and Florence, to the greater disturbance suffered by the levels in the last-mentioned locality. He concludes generally that geographical latitudes astronomically determined, and applied to the measurement of degrees of meridians, may be an imperfect means for discovering with great precision the general form and dimensions of the earth, and that so delicate a research requires the concurrence of geodesical resources. This is illustrated by a table in which nine arcs of meridian obtained in Italy with every possibly care, ranging from one degree and upwards to nearly four degrees, and their respective astronomical, geodesical, and theoretical values are exhibited, with their more or less striking differences.*

* In the appendix to the *Connaissance des Temps* for 1827, Arago, in giving an account of these differences in Higher Italy, omitted all mention of Inghirami, who had been the first to call attention to them. Similar anomalies have been found in all other countries.

A controversy was carried on between M. Puissant and the Padre Inghirami relative to a certain measurement in the French trigonometrical operations, which differed considerably from the Italian. Though naturally biased in favour of his revered predecessor and valued teacher, the P. Antonelli treats this subject with great candour, fairness, and temper; and after a most laborious and searching investigation, which he minutely details, gives a verdict in favour of the French geometer.* If a critical selection of the immense mass of observations accumulated in ten years, by the learned Scolopian, showed that he was mistaken in this case, it is no small credit, as Antonelli remarks, "that those observations, in general, fairly bear comparison with others effected with much superior means, and with higher objects in view."

The next labour of Inghirami was the preparation of a copious hypsometrical table for Tuscany, embracing the question of the difference or the identity of level of the Mediterranean and Adriatic Seas. Some observations of rare excellence, under favourable circumstances, seemed to indicate a slight difference; but considering the influence here operative also of local attractions, and the delicacy of the investigation, the Father judiciously refrained from drawing any conclusion. In 1829, he was enabled to lay before the public his long-designed geometrical map of Tuscany, including the confines of the neighbouring States. For the sea-coasts, the charts of Puissant and Captain Smyth furnished materials. The scale was the $\frac{1}{100,000}$th part of the actual size,† and the proportion between the earth's polar and equatorial axes was assumed 309 : 310. This was considered one of the finest works of the kind that had hitherto appeared. Previously to this, however, Inghirami, with other co-adjutors, had published an ephemeris of Venus, Jupiter, and Mars, for navigational purposes. The only attempt in this direction had as yet been made by the Danish Government. Neither of the Boards of Longitude of London or Paris had attended to the subject.‡ The ephemeris appeared in 1820, and in the prefatory remarks, Inghirami refers with complacency to the circumstance, that whether they should be able to continue it as they desired or not, fellow-citizens of the famous Vespucci had the merit of turning to practical account the same method of determining longitudes which that great navigator was the first to conceive.

At the close of 1825, the Royal Academy of Sciences in Berlin proposed that the astronomers of Europe should unite for the construction of a new celestial atlas, with stars down to the ninth or tenth magnitudes, including the space between the parallels of 15° N. and S. Declin., divided by the twenty-four hours of R.A., and to be completed in two years. Inghirami accepted the general invitation, and was intrusted with one of the most difficult portions, the eighteenth hour, very abundant in stars, and moreover traversed by the Milky Way. Using only an annular micrometer applied to a telescope, by Fraunhofer, of five-feet focus, and with the invaluable assistance of his former pupil and then associate, P. Tanzini, an excellent observer, he found himself within a year furnished with over seven thousand observations. These fixed with sufficient

* The distance in question was made rather too short by Puissant, and considerably too long by Inghirami; the probable errors being 6 and 17 toises respectively, and the true length 11876.30 toises.

† Rather less than $\frac{1}{2}$ in. to a mile.

‡ The distances of the moon from Venus, Mars, Jupiter, and Saturn appeared in the *Connaissance des Temps*, for 1832. The improved *Nautical Almanac* appeared in 1834.

accuracy the positions of 3,750 stars, of which only 1,716 were determined for the first time, the rest being contained in the catalogues of Piazzi, Lalande, and Bessel. Of five or six stars inserted in these catalogues, no trace at all could now be found. Inghirami, who had been the last to receive a commission in this work, was yet the first to remit his portion. It was not only complete in every respect, but engraved, accompanied with letter-press in folio, with every detail of the observations, and subsidiary tables used for their reduction, &c., not omitting distinct mention of the names of those, including seven of his own pupils, to whose unwearied co-operation in the calculations and various departments of the work he was so much indebted for its happy and deservedly applauded issue.

Sensible that mathematics are the foundation and the very life of the sublime science of the stars, this indefatigable philosopher gave especial attention to their promotion. An edition of Gardiner's Logarithms, several times before reprinted in Florence, under the care of the meritorious Fathers Canovai and Del Ricco, was by him improved, extended, and enriched with copious formulæ. He also greatly improved successive editions in Italian of the course of mathematics by the French abbot, Marie, founded on the Lessons of the celebrated La Caille. The preparation of the eighth edition occupied him during 1833, and notwithstanding certain imperfections, unavoidable under the circumstances of its compilation, it was, in the judgment of Antonelli, capable of being easily made one of the best works of the kind that learners could use.

"If," says his biographer, "we call to mind what we have related of the laboriousness of our Inghirami, the range of his acquirements, the acuteness and fertility of his genius, the value of the pains he took for the advancement of the sciences of geodesia, astronomy, and mathematics, and the frank and interesting publicity he always gave to his labours, we shall not be surprised at the universality and splendour of his fame. Almost all the academies and scientific associations of Italy honoured him with diplomas. The Royal Astronomical Society and the Royal Geographical Society of London, and the Geographical Society of Berlin, enrolled him among their members. The Government of Tuscany conferred on him a handsome pension, as a reward for the important services rendered by him to science and to the State; and the Emperor of Austria decorated him with the order of the second class of the Iron Crown; nor did the learned both of the old and the new Continent, who visited la Bella Firenze, leave it without paying him the tribute of their sincere and respectful homage."

Advanced since 1826 to the charge of Superior, or Provincial, as it is termed, of the Scuole Pie in the Grand-Duchy, P. Inghirami strenuously promoted the cause of education. Besides founding a new house of instruction; increasing the subjects of study in the schools; extending the teaching of Italian, and introducing that of Greek, he produced anonymously in 1832, an admirable work on geography, in which lucid scientific exposition is so interspersed with matter of a biographical, artistic, literary, and moral nature, as to invest the whole with a peculiar charm and interest.

Inghirami had been obliged from his youth to use very powerful spectacles. To continuous and severe mental application it may have been partly owing that in 1836 he was unable to read with glasses of any kind. This calamity he bore with calmness and serenity. He continued to preside over his Order in Tuscany, and with the aid of some clever pupil or other, carried on the lessons in higher mathematics and astronomy. In 1839 he underwent a successful operation for cataract, by which his vision was tolerably restored to the end of his life.

During his tedious convalescence, he occupied his mind, though enjoined an almost complete repose from intellectual work, with two projects. The first was the amplification of his beloved observatory, which, notwithstanding its improvement under his directions, was too confined for the new instruments he had acquired and those which he proposed to procure. He was enabled to devise and subsequently carry out a plan for this, which was perfectly satisfactory. The other was to provide more efficiently for the religious instruction of the increased number of the Scolopian pupils. A monumental stone in the "rich and elegant" chapel, constructed for this purpose at his own expense, commemorates the founder's name and his pious object. Called to succeed the Supreme Moderator, or General of the Calasanzian Order in Rome, Inghirami was obliged to remove to that city. His sensitive spirit and timidity in matters of a social and official nature, led to his resignation of this office in a year's time. He had not enough *iron* in his temperament for this new sphere; and Gregory XVI., willing to oblige him, consented that he should return to Tuscany, and thence carry on his functions as Superior during the remainder of their term, which expired in 1848. In the year following Inghirami retired from public and scientific life to devote the remainder of his days to spiritual exercises and contemplation. Not, however, that he was indifferent to his loved sciences. In his humble cell in S. Giovannino, he would cause some good periodical treating on mathematics and astronomy to be read to him, and thus continued to follow with pleasure questions of scientific interest. On the occasion of the great solar eclipse of July 28, 1851, he repaired to the Observatory to take part in its observation, which greatly delighted him. He was then above seventy years of age. From that day his bodily weakness increased till he was confined to his bed, and calmly died, on the 15th August, of congestion of the brain. His funeral was numerously attended by all classes, and a brief but eloquent and affectionate *éloge* pronounced over his remains by Professor Barsottini, of the Scuole Pie. A marble bust of the deceased is in the Ximenian Observatory, and a portrait in the College of S. Giovannino.

Grave in countenance, and sparing of his words, Inghirami did not appear at first sight to possess the kind, amiable, and modest spirit that was enshrined beneath an undemonstrative and seemingly severe exterior. Though he felt keenly, he displayed much patience and calmness under trying circumstances. One day, whilst preparing for an observation in in his observatory, a young assistant overset a fine telescope by Dollond, and was in a state of breathless agitation. Inghirami, seeing the object-glass in fragments, exclaimed, cheerfully, "Oh! we must order another directly from Monaco;' * and this he did without another word about the unfortunate accident. About noon, on the 19th August, 1849, there was a terrible tempest, which suddenly caught the revolving dome of the Observatory, beneath which was the large telescope, and hurled them both into a court of the College. All were afraid to announce such a misfortune to the Father, fearing he would take it so much to heart; but at length, in reply to his repeated inquiries concerning the crash he had heard, they were obliged to tell him that the new telescope (it had hardly been mounted three months), seized by the storm, was lying together with its dome on the roof of the room of the Prefecture of the Schools. "Only think," he said, "where it has gone and tumbled!"

* Where the celebrated optician Reichenbach lived.

(*Senti dov'è ito a cascare!*) and he quietly resumed what he was engaged in.*

The dignified imperturbation of Inghirami, which became proverbial amongst his scholars, sometimes gave way under severe grief. On the occasion of the loss of a most valued pupil of rare promise, who died at the age of eighteen, whilst executing some part of the Tuscan survey, he did not leave his room for three days; and in a letter to Baron De Zach, after speaking of his loss and his great sorrow, he says that if he were to yield to his actual feelings, he should train up no more pupils; not only from the impossibility of his having another who should at all approach the merit of the one thus snatched from him, but to avoid exposing himself ever again to the bitterness of seeing dissipated in a moment the brightest hopes from an education bestowed with so much pains and so much success.

To say that, as Protestants, we find in the subject of this biography some things we could have wished other than they were, and that we are obliged now and then to differ seriously from his esteemed biographer, is to confess—from our point of view—that we find neither in the one nor the other exemption from errors and infirmities that, in however different ways, are found more or less in all of us. It is unnecessary here to dwell further on these points.

Remarking that man has something besides his intellectual faculties to cultivate; and that great endowments, whether in science, literature, or art, unaccompanied by religion, conscience, and right affections, have often rendered their possessors the very reverse of blessings to society, Antonelli thus concludes his account of Inghirami's life and labours :—" Solidity and breadth of literary culture ; vastness of scientific learning ; subtilty, and mental capacity for the most abstruse subjects ; a spirit of observation ; richness of conception ; indefatigable laboriousness ; a power of effectively attending to various important works at the same time ; an extraordinary talent for achieving considerable results with scanty materials and resources ; original and interesting geometrical contributions ; the complete dedication of a long and untiring life to the furtherance of valuable knowledge, and of the public benefit ; the sacrifice of earthly fortune, of the pleasures and lawful affections of the family; conduct in social and sacerdotal life pure, severe, exemplary; sensibility and tenderness of heart; an inflexible love of truth and justice ; a sincere piety from intimate conviction; a living love of God and man. Here, in a few touches, is the spiritual picture of Inghirami ; here are the fine qualities which in no ordinary measure shined in him, and that made him wise amongst the people, esteemed among the learned, celebrated everywhere. He was therefore great as to heart, as to morality, and as to mind ; and it may be affirmed, without fear of exaggeration, that he was a great man !"

Antonelli's excellent memoir is now very scarce ; and the writer of these notices, who is indebted to it for the substance of the greater part of them, and has often borrowed its expressions, desired by them to pay a tribute to the memory of his former instructor, and to present to

* We may be reminded of an anecdote of our own Colby, whose command over his temper was perfect. Once, while encamped on Slieve Donard, in Ireland, the summit of Sca Fell, in Cumberland, became visible at the distance of 111 miles, and after many trials the instrument was brought to bear upon it. Colby was on the point of successfully finishing his observation, which would have been a geodesical triumph, as including the longest side of a triangle ever attempted, when an officer on entering the observatory accidentally struck his elbow, and threw the telescope off the object. A momentary ejaculation of anger escaped his lips, but though he could not again succeed, and the object was therefore lost, he never afterwards alluded to the subject.—*English Cyclopædia.*

youthful astronomers and mathematicians in this country a few pages which might be read not without some interest and advantage. It was his privilege, forty-five years ago, to study for a time under Inghirami, and to gratify in the halls and the observatory of the palatial College of S. Giovannino an early fondness for the subjects which that eminent, but most unpretending man, as well as other distinguished associates, taught with equal suavity and skill. Both from personal knowledge of P. Inghirami (whom he saw again for the last time in 1840) and his writings, he is able to some extent to testify to the truthfulness of the portraiture drawn by his biographer—a portraiture not to be distrusted because it seems to glow with the warm tints of an Italian sky—and he will rejoice if, by this slight sketch, the character and labours of one who was so highly esteemed in other countries, shall be still more widely and deservedly appreciated in our own.

G. J. W.

Light Science for Leisure Hours. By Richard A. Proctor, B.A., F.R.A.S. London : Longmans.

It has been many times a subject of regret that the valuable essays which so frequently appear in the daily and weekly press should not be preserved in a convenient form for future reference ; written as they are, while the subjects are fresh in our minds, they cannot fail to be faithful and interesting records of the matters of which they treat. It is impossible that we can have been alone in the thought that Mr. Proctor's excellent contributions of this nature are deserving of preservation, and it is therefore gratifying to find them now before us, so collected as to form a volume of like character to his other recent works, "The Sun," "Other Worlds than ours," &c. Although the papers in the present book are chiefly astronomical, Mr. Proctor's powers have not been entirely confined to that subject, and the titles of some of the papers—"The Gulf Stream," "Floods in Switzerland," "Mont Cenis Tunnel," "Long Shots," "Influence of Marriage on the Death Rate," "Betting on Horse Races," &c.—show that he has applied his excellent powers as a writer and mathematician to subjects of very varied character. We feel sure that all who are acquainted with Mr. Proctor's excellent writings will be glad to meet again his fugitive pieces in a convenient form for the library.

THE GREAT NEBULA OF ETA ARGUS.

Our good Correspondent in New South Wales, Mr. McDonnell, has favoured us with a copy of the *Sydney Morning Herald*, of May 13 last, from which we extract the following report of a very interesting paper by Mr. C. H. Russell, the Government Astronomer, read at the meeting of the Royal Society of New South Wales, on the 10th of May this year :—

In the months of January and February of the present year I surveyed carefully, with the fine refractor of the Sydney Observatory, the stars and nebula about the remarkable variable Eta Argus. The observations I have already printed and sent to Sir John Herschel, who has shown the greatest interest in the changes which have from time to time been reported in this object, and whose beautiful monograph of 1843 enables us now to trace some of the most wonderful changes that have ever been witnessed by astronomers.

I then omitted some results of the survey, as I did not wish to give anything as evidence which might be biased by my personal convictions. Upon these I have based the few remarks I have to make this evening. And as the subject may be new to some of the members of this society, a few historical notes may not be out of place.

In 1677, when observed by Halley, at St. Helena, Eta Argus was of the fourth magnitude, thence to 1751 it does not appear to have been observed, but in that year Lacaille called it second magnitude. Another long interval, and Mr. Burchell—1811 to 1815—noticed that it was fourth magnitude. 1822 Fallows calls it second magnitude; and in 1827 Burchell noticed that it had increased to the first magnitude; and writing to Mr. J. Duncan, in 1827, says, "I am curious to know whether any one has observed that Eta Argus, which is marked as fourth magnitude, and was always so when I was in Africa, is now of the first magnitude, or as large as Alpha Crucis." No one, however, but himself seems to have noticed it, and he did not publish the fact. When Sir John Herschel went to the Cape in 1834, he began his observations on Eta Argus, which was then about the second magnitude, and continued so up to November, 1837; on the 16th of December, when again examining the star, he was very much surprised to find it had increased to the first magnitude, and was one of the brightest stars in the heavens. This naturally excited his curiosity, and led him to watch it closely to the following April (1838), when his departure from the Cape prevented further observations of it. Up to the 2nd of January, 1838, it continued to increase, and was then equal to Alpha Centauri; after this it faded gradually, and on the 14th of April was about equal to Aldebran and Leonis.

In 1843, Sir Thomas Maclear, at the Cape, observed it much brighter than Alpha Centauri, and rather brighter than Canopus, and on the 14th of March thought it almost equal to Sirius. As Sir John Herschel estimated Canopus as double, and Sirius as quadruple of Alpha Centauri, Eta was at that time probably triple Alpha Centauri; it then faded again, but in 1845 was brighter than Canopus, and had been so for some time. These observations proved the extraordinary fluctuations of the light of this star, and made it one of the most interesting objects in the heavens, which the observations of various astronomers since have in no way tended to lessen. From their published results I have, for convenient reference, drawn up the attached list. It contains the observations from which Professor Loomis, in April, 1869, deduced the generally accepted period of 67 years, and some additional ones.

Professor Wolf, in 1863, thought that a period of forty-six years would satisfy the observations; but Professor Loomis found that subsequent observations, especially those of Mr. Tebbutt, could not be satisfiedexcept by assuming a longer period, and gives the result of his investigations in vol. xxviii. R.A.S. Notices. His diagram exhibits minor fluctuations of light, which may, perhaps, in some cases be accounted for by errors in the observations but not in all; and there can be no doubt that Eta is subject to strange minor fluctuations of light in addition to its periodical variation.

Sir John Herschel (in 1843), (at page 36 of the Cape Observations), says "A strange field of speculation is opened up by this phenomenon—the temporary stars heretofore recorded have all become totally extinct. Variable stars, so far as they have been attended to, have exhibited periodical alterations in some degree at least regular, of splendour and comparative obscurity. But here we have a star fitfully variable to an astonishing extent, and whose fluctuations are spread over centuries. Its future career will be a subject of high physical interest." Since 1845 Eta has gradually faded, and is now (1871) only a 7th magnitude star; less than it has ever been observed before, and, perhaps, going like all other temporary stars into darkness: certainly with its fading light throwing many dark shadows in the way of any speculations on the constitution of temporary stars.

Of the nebula about it little notice seems to have been taken for a number of years; the difficulty of drawing it would deter most observers, and the differences observed naturally attributed to the difference in the instruments. The Cape drawing being always received as its appearance in a large telescope; for this drawing the observations extended over the years 1834, 5, 6, 7, and part of 8, and nothing was then seen to lead to the supposition that any change was going on in the nebula or stars.

(To be continued.)

THE PLANETS FOR AUGUST.

At Transit over the Meridian of Greenwich.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	10 5 30	+12 46½	5″·6	1 26·6
	15th	11 17 5	3 29½	6″·6	1 43·0
Venus ...	1st	11 34 19	+1 17	28″·4	2 25·2
	15th	12 8 22	−4 37	34″·8	2 34·1
Mars ...	1st	13 26 4	−9 36	7″·8	4 46·7
	15th	13 57 45	12 48	7″·4	4.23 2
Saturn ...	1st	18 18 41	−22 40½	16″·4	9 38·5
	15th	18 15 58	22 44	16″·2	8 48·9
Neptune ...	29th	1 30 41	+7 37½	2″·0	14 59·2

Mercury passes the meridian an hour and a half after noon, and consequently is an evening star and fairly visible.

Venus sets earlier each day; at the end of the month only a few minutes after the sun.

Mars is still to be seen, but only for a short time after sunset. He sets about two hours and a quarter after the sun at the beginning of the month, the interval gradually decreasing.

Saturn is well situated for observation through the greater part of the night.

ASTRONOMICAL OCCURRENCES FOR AUGUST, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
			Sidereal Time at Mean Noon, 8h. 38m. 36·81s.			—
Tues	1	6 14	Conjunction of Mars and h Virginis 0° 7′ N.	2nd Sh. I.	16 17	9 38·5
		7 50	Conjunction of Mercury and α Leonis (5m.·6) W.			
Wed	2	9 26	Occultation reappearance of τ^2 Aquarii (4)			9 34·3
Thur	3		Sun's Meridian Passage, 5m. 56·58s. after Mean Noon	2nd Oc. R.	14 26	9 30·2
Fri	4			1st Sh. I.	16 13	9 26·0
Sat	5	1 55	Conjunction of Mars and α Virginis (16m.·2) W.	1st Oc. R.	16 27	9 21·9
		5 12	Conjunction of Mercury and ρ Leonis (3m.·4) W.			
Sun	6					9 17·7
Mon	7	16 23	☾ Moon's Last Quarter			9 13·6
Tues	8					9 9·5
Wed	9					9 5·4
Thur	10	15 4	Occultation of o Tauri (6)			9 1·2
		15 48	Reappearance of ditto			
			Saturn's Ring: Major Axis=40″·38 Minor Axis=17″·89			
Fri	11	12 41	Occultation reappearance of 6 Geminorum (6)			8 57·1
		13 22	Near approach of η Geminorum (3½)			
Sat	12	22 58	Conjunction of Moon and Jupiter, 1° 32′ S.	1st Ec. D.	15 29 41	8 53·0
Sun	13	19 8	Conjunction of Moon and Uranus, 1° 57′ S.	1st Sh. E.	14 54	8 48·9
				1st Tr. E.	15 37	
Mon	14					8 44·8
Tues	15	16 1	● New Moon			8 40·7
			Illuminated portion of disc of Venus=0·307			
			,, Mars=0·886			

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Wed	16	0 27	Sidereal Time at Mean Noon, 9h. 37m. 45·13s. Conjunction of Jupiter and δ Geminorum (8m.·4) W.			8 36·7
Thur	17	19 32	Conjunction of Moon and Mercury, 7° 5′ S.	2nd Ec. D.	15 41 40	8 32·6
Fri	18	18 33	Conjunction of Moon and Venus, 9° 54′ S.	1 Tr. I.	15 28	8 28·5
Sat	19		Sun's Meridian Passage 3m. 30·22s. after Mean Noon	1st Sh. E. 2nd Tr. E.	13 33 15 11	8 24·4
Sun	20		Venus at greatest brilliancy	1st Sh. I. 1st Tr. I. 1st Sh. E.	14 30 15 19 16 48	8 20·4
Mon	21	2 45	Conjunction of Moon and Mars, 5° 16′ S.	1st Oc. R.	14 57	8 16·3
Tues	22	23 35	☽ Moon's First Quarter	3rd Sh. E. 3rd Tr. I.	14 20 14 30	Moon. 5 7·9
Wed	23					6 1·9
Thur	24					6 59·3
Fri	25	8 13	Conjunction of Moon and Saturn, 1° 3′ N.			7 59·6
Sat	26	7 14 8 20	Occultation of χ′ Sagittarii (6) Reappearance of ditto	2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	13 17 15 6 16 8	9 1·2
Sun	27			1st Sh. I.	16 24	10 1·9
Mon	28	12 30 15 15	Near approach of ε Capricorni (4½) Occultation of κ Capricorni (5)	1st Ec. D. 1st Oc. R.	13 45 23 16 57	10 59·9
Tues	29	18 20	○ Full Moon	1st Sh. E. 1st Tr. E. 3rd Sh. I.	13 10 14 7 15 7	11 54·3
Wed	30		Saturn's Ring: Major Axis=39″·26 Minor Axis=17″·47			12 45·0
Thur	31					13 32·6

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN AUGUST, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight. ° ′	Objects to be observed.
18	... 147 16·7 ...	Mare Crisium, direction of the central ridges.
19	... 134 4·4 ...	Cleomedes, Burckhardt, Geminus (*a*).
20	... 122 7·1 ...	Macrobius, Proclus, Mt. Glaisher (*b*).
21	... 109 17·3 ...	Mare Nectaris, eastern part.
22	. 96 18·8 ...	Aliacensis, Werner (*c*), Reaumur.
23	... 83 12·2 ...	Region north of Aristoteles.
24	... 69 58·6 ...	Sasserides, Pietel, Sassure.
25	... 56 39 2 ...	Carlini, Sinus Iridum (*d*), Lambert.
26	... 43 16·2 ...	Gassendi, group of central mountains (*e*).
27	... 29 53·4 ...	Anaximander, Galileo, Lehmann.
28	... 16 35·0 ...	Bettinus, Kercher, Wilson.
29	... 3 26·2 ...	Zuchius, Hausen, Bailly.
30	... —9 27·9 ...	Wilhelm, Humboldt, Phillips (*f*).
31	...—22 3·3 ...	Objects between the west limb and terminator.

For additional objects consult the lists for April and June.

The moon is now approaching a state of mean libration, which it attains about October 4, 1871. From the 18th to the 24th of August, objects will be north and west of their mean places on the apparent disc. Afterwards they will be south and east. As the morning terminator passes over objects with west longitude, the visual angle will be unfavourable for studying the interiors of large formations, but favourable for observing decreasing foreshortening. The state of the apparent disc on the 24th will not deviate greatly from that of mean libration.

Guttemberg and Stöfler.

In the *English Mechanic*, No. 326, June 23rd, p. 336, will be found a sketch of Guttemberg and its surroundings, by Birmingham, the discoverer of T coronæ. See also the list for July note (*a*). Attention is particularly directed to an interior ring S.E. of the ring on the N.W. of Guttemberg, both were first recognised by Mr. Birmingham in 1869. A sketch of Stöfler, by the same obesrver, will be found in the *English Mechanic*, No. 328, July 7, p. 386.

(*a*) Drawings and descriptions of these objects will be valuable.
(*b*) A high mountain near Proclus, named by the late Dr. Lee to commemorate the highest balloon ascent.
(*c*) The Rev. T. W. Webb announces that the bright spot in Werner, which according to Beer and Mädler equalled if not exceeded Aristarchus in brilliancy, has certainly faded, and is now below many other luminous spots on the disc.
(*d*) The system of ridges from La Place to Heraclides is well worthy of study.
(*e*) Attention is directed to Gassendi, that its earliest illumination may be caught, as good drawings and descriptions of the interior are very desirable.
(*f*) These formations very near the west limb may probably be seen, as by libration they are east of their mean places.

OBSERVATIONS FOR AUGUST, 1871.

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, midnight		60°N.		0°		60°S.
			Sunset.			
1871. August 1	...	+68°6	...	+66°9	...	+65°2
2	...	56·4	...	54·7	...	52·9
3	...	44·3	...	42·5	...	40·7
4	...	32·1	...	30·3	...	28·5
5	...	20·0	...	18·1	...	16·2
6	...	+7·8	...	+5·9	...	+4·0
7	...	−4·4	...	−6·3	...	−8·3
8	...	16·6	...	18·5	...	20·5
9	...	28·8	...	30·8	...	32·8
10	...	41·0	...	43·0	...	45·0
11	...	53·2	...	55·2	...	57·3
12	...	65·4	...	67·5	...	69·6
13	...	−77·6	...	−79·7	...	−81·8
			Sunrise.			
17	...	+49·1	...	+51·3	...	+53·5
18	...	36·8	...	39·1	...	41·3
19	...	24·6	...	26·8	...	29·1
20	...	12·3	...	14·6	...	16·9
21	...	+0·1	...	+2·4	...	+4·7
22	...	−12·2	...	−9·8	...	−7·5
23	...	24·4	...	22·0	...	19·7
24	...	36·6	...	34·2	...	31·9
25	...	48·8	...	46·4	...	44·0
26	...	61·1	...	58·6	...	56·2
27	...	73·3	...	70·8	...	68·4
28	...	−85·5	...	−83·0	...	−80·5
			Sunset.			
30	...	+75·1	...	+72·6	...	+70·1
31	...	+63·0	...	+60·5	...	+57·9

M.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Sept. 1871.	To Dec. 1871.	To Jan. 1872.
Cotsworth, H. Hemming, Rev. B. F. Jackson-Gwilt, Mrs.	Andrews, W. Banks, W. L. Fleming, Rev. D. Glover, E. Knott, G. Lee, Allen Noble, Capt. W. Smelt, Rev. M. A.	Green, S. McAdam, J. V. **To March, 1872.** E'ger, T. G. **To June, 1872.** Forest School, Walthamstow.

July 24, 1871. Subscriptions after this date in our next.

TO CORRESPONDENTS.

Several Papers are deferred for want of space.

A Correspondent asks, "Who was that Sir Michael Newton who attended Sir J. Herschel's funeral as chief mourner?"

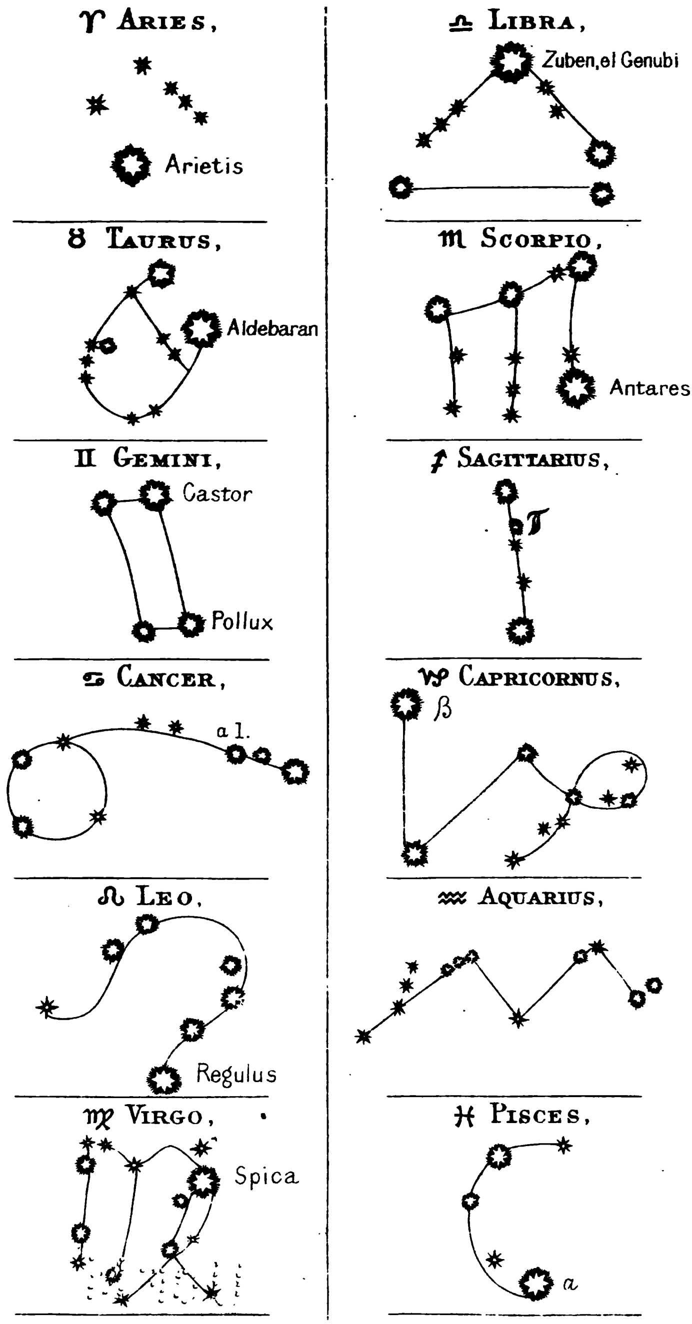
Erratum in No. 103, p. 168, line 7, for *chime* read *drive.*

THE INDEX AND TITLE to the last Volume of the *Register* is, we regret to say, not yet ready, but we hope will soon be completed; due notice will be given to Subscribers.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, Mr. S. GORTON, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

THE ASTRAL CIPHER EMBLEMS OF THE SIGNS.



The Astronomical Register.

No. 105. SEPTEMBER. 1871.

ASTRAL ORIGIN OF THE CIPHER EMBLEMS OF ASTRONOMY.

By The Rev. J. H. Broome, Vicar of Houghton, Norfolk.

Little, if anything, appears to be known as to the origin of the cipher emblems which express the Twelve Signs of the Zodiac.

Desirous of ascertaining all that was known on the subject, the author asked one of the most eminent astronomers of the day for information. All that he obtained from so highly accredited an authority was, "That neither himself, nor did he think any one else could give a satisfactory answer to the question, the emblems appearing to have their origin in a very remote antiquity."

As to astronomy itself, it was the opinion of Josephus, and more ancient authorities likewise, that this science commenced in the family of Seth, the son of Adam. (Josephus, B. I. c. III. & IV. See also "Notes to Gill's Com. on Genesis," where the names of ancient writers—Jewish, Persian, and Arabian—are given as to the truth of this testimony.) Now, if the statements we find given in the authors referred to be true, it will go far to account for the fact, that so extremely little is known in our day of the origin of these emblems. Is not simplicity the characteristic feature of things most ancient? In the earliest stages of our world's history, its inhabitants had comparatively but few speaking objects before their eyes, in the use of which, as by emblems, they could fitly express their ideas. For the convenience of expressing by ciphers the Twelve Signs of the Zodiac, would not the ancient sages naturally have recourse to *astronomy* itself, in its suggestive starry configurations, and having, with a strong vision in a clear Eastern sky, carefully marked out in each of the Twelve Signs its own appropriate ciphers, have they not come down to us through a long vista of many ages?

Impressed with this thought, the author most carefully set to work to examine the starry configurations of the Twelve Signs, feeling assured if his theory was a right one, he would find that each one of the cipher emblems would be found to consist, or include at least, the *chiefest* stars in each sign. The very close resemblance of the stars to each appropriate cipher may be seen on the plate. Surely such repeated copies, as one is from another, cannot be attributed merely to so many coincidences; for let the objector, in any one of the instances drawn on the plate, make a transposition, that is, attempt to find the shape of one of the twelve cipher emblems in any other sign (taking in the chief stars) than that in which it ought to appear, and he will find his labour to be in vain.

Plato in Cratylus says: "Names are pictures of things, having some resemblance to the things named." Applying the remark to the stars which give name to the sign Aries, we see some resemblance to the side horns of a ram, as given in its appropriate cipher. In Taurus, likewise, the upper stars resemble the two horns of a bull. In Gemini, it is the uniting of two similar figures which gives one an idea of the twin-union. In Cancer, four circular stars give a notion of the crab. In Leo, not a faint conception is given of the attitude in which a lion stands when he is facing you. In the stars of Virgo, we can trace no resemblance to a virgin, save that its chief star, Spica, seems carried as by a virgin. In Libra, the resemblance of its stars to a balance is plainly drawn. In Scorpio, nothing but the protrusion, as it were, of its chief star, Antares, as in its cipher, reminds us of the scorpion's sting. Sagittarius is shaped not unlike an arrow. In Capricornus, an imaginative person only will see any resemblance to the goat. Aquarius reminds us of the agitated waves of the sea. In Pisces, one figure is drawn as in Cancer. It may represent a fish when *bent*; but, however this may be, taking the twelve ciphers together, they either more or less resemble the objects they represent, and the starry configurations also of the Twelve Signs of the Zodiac.

If the antediluvians found appropriate ciphers in the Twelve

Signs of the Zodiac to represent the signs themselves, it is but going one step farther to say, that they found in the natural configurations of the constellations their one primæval alphabet.

That astronomy and the primæval alphabet originated much about the same time, was an ancient belief, as it is by some Jewish Rabbins in our day. In the December Number of the *Astronomical Register* for 1870, the author has given drawings from the stars of what seems to come extremely close to the true primæval alphabet. These drawings are now published by Macintosh.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

ON THE CONTEMPLATION OF THE SIDEREAL HEAVENS.

In the concluding lines of the *Prolegomena* to the "*Bedford Catalogue*," Admiral Smyth says of the reader who has accompanied him through them—"Armed with a telescope he may immediately employ his time to advantage; and even if without one, his contemplation of celestial objects must have increased in interest." "Look up," said Richter, "and behold the eternal fields of light which lie around the throne of God! Had the stars never appeared in the firmament, to man there would have been no heavens; but he would have laid himself down to his last sleep in a spirit of anguish, as upon a gloomy earth, vaulted over by a material arch, solid and impervious." To the thoughtful person, even without optical appliances, the survey of the heavens is indeed delightful; and the well provided observer, too, will at times experience the enjoyment of leaving his instruments, and abandoning himself beneath the canopy of the skies to the contemplation of those "eternal fields of light" with which modern discovery has linked such wonderful associations. Not that one unprovided with the humblest telescope is precluded from useful observation. He can trace and map out, by careful alignments, the paths of planets and comets. He can note colours and magnitudes, and to some extent variations in the latter. Meteors, periodical and irregular, various phenomena in eclipses come within his reach: and he can rate his watch to a considerable degree of accuracy, by the disappearance of stars behind a building. But apart from all this, there is something soothing to the mind in the contemplation of the starry vault after the business and cares of the day are past. There is a music in the spheres perceptible to the spirit, though not to the ear; and the grand but noiseless march of the constellations seems to reprove the often undue place we are apt to give to our terrestrial pleasures and pains. And, in the presence of such glories, do we not learn a lesson of humility; and is not a sense of our own littleness pressed upon us, that can find no better expression than in the inspired language of the Psalmist (Ps. viii. 3, 4)? The honours, whatever they be, the rivalries and contentions of the world must seem trifling, as we gaze upon the bright and distant orbs that shine in the immensity of space; and whose general apparent fixity strikingly contrasts, as it ever has done, with the changeableness and the vicissitudes of mundane things. For we survey in the arrangement of the stars, the same, or at least the little altered, constellations beheld by the earliest observers of our race: and we are in a manner brought into fellowship with the host of astronomers of all ages who studied the stars before us, and read, so to speak, out of the same book.

The contemplation, however, of the nocturnal skies, derives a vastly greater interest when we connect with it the light which modern science has thrown upon the scale of the visible universe. Illustrations are common in our astronomical books. Let us choose one which may be easily carried in the memory, and let us take the distance of Neptune* as a modulus for that of the nearest stars. The distance of Neptune being thirty times that of the earth from the sun, we shall find that an express train, moving at the rate of sixty miles an hour without stopping, would reach that planet in 5,219 years.† Supposing some such rapid locomotion possible, and that Enoch (born according to the common chronology, B.C. 3382) had availed himself of it when he was thirty-four years of age, he would but just now have arrived at Neptune; and from thence he would behold the sun of the same apparent magnitude as Venus, when a morning or evening star, only immensely more bright. In the general aspect of the heavens, and configuration of the constellations, he would see no difference. The same star-maps he might have taken with him would serve there as well as here; the comparatively small changes occasioned by proper motions in the five thousand years of his journey alone excepted. And supposing such a journey instantaneously accomplished, a star would only suffer a displacement of half a minute of arc, at the most, from the position in which it would be viewed from the earth. This consideration, that the change of our point of view from the earth to Neptune would make no difference in the aspect of the heavens to the naked eye, is well calculated to give an idea of the vastness of the universe.

Using now the modulus we have chosen to measure the distance of the nearest fixed stars, we find it must be, in round numbers, 6,900 times that of Neptune from the sun. But this, it must be remembered, is a minimum; and very many, if not most, are probably far more remote. As far as *space*, then, is in question, there would be room for not a few more planets in our system far more distant than even Neptune, without their being disturbed by the attraction of the stars. The great comet of 1680 recedes, it has been supposed, to a distance from the sun greater by more than twenty-eight times that of Neptune; from which the apparent diameter of the sun would be only 2″; and the aphelion distance of the comet II. of 1844, to which a period of 100,000 years has been assigned, has been computed to be above 142 times the distance of Neptune from the sun. These cometary calculations, however, are to be regarded as far from being entirely reliable.

The enormous scale of the universe is also forcibly brought home to us, when we reflect that although we change our position every year in

* The name given to the remotest known planet happens to accord well with the belief held by many of the Hebrews, and some of the Christian Fathers in a super-celestial ocean, which has also appeared to some countenanced by various passages of Scripture. Ps. cxlviii. 4, &c.

† It would reach the moon in five months and a-half.

space more than 150 millions of miles—that being the sun's rate of motion, together with the whole solar system—and although many of the stars themselves—probably all—are in motion, and some of them far more rapidly, the eye detects no change in the heavens, from year to year, or from century to century. Repose is in reality nowhere: notwithstanding that immense distances and universal motion would persuade our vision that it is found among the stars. The Great Bear, Orion, and the Pleiades, are beheld by us as they were seen by the contemporaries of Job and Homer.

If it is impossible to think of the awful space that separates our sun and the remotest planet, or comet, that owes allegiance to it, from the nearest "fixed" stars—space of a temperature intensely cold,* filled with the etherial medium, and traversed by numberless meteoric bodies and comets; occupied, too, in parts, perhaps, by masses of gaseous or nebulous matter—there is another consideration which enhances the interest with which we contemplate the starry heavens, and that is their probably vast antiquity. We have not, it is true, the same sort of evidence that geology affords of the enormous age of our own globe, yet the antiquity of the latter affords a fair presumption of a still greater for many other celestial bodies. It would seem also that the grandeur itself of the scale of the universe, and the time required for the revolutions of many of the multiple stars is an argument either for a designed vast period of future duration, or one of past existence; while both may very likely be true. The element of time, we might infer, would harmonise in its proportions with that of space. Some would, probably, now at least hesitate to acquiesce in the conclusion of the elder Herschel in 1802, when he wrote as follows; "Hence it follows, that the rays of the light of the remotest nebulæ must have been almost two millions of years on their way, and that consequently so many years ago this object must already have had an existence in the sidereal heavens, in order to send out those rays by which we now perceive it." But in the various stages of apparent condensation of the nebulæ, from the diffuse mist to the perfect star, we still appear to behold in these wonderful bodies evidence of different degrees of high antiquity. In a paper in the *Cornhill Magazine* for July, entitled, "The Herschels and the Star depths," the writer,† alluding to Sir William Herschel's later investigations, and in reference to "different milky nebulæ which seemed to belong to different stages of growth, from an exceedingly faint and altogether irregular nebulosity, to rounded nebulæ, nebulæ with faint centres, nebulæ with bright centres, nebulæ consisting almost wholly of a bright central light (the outer portion being scarcely discernible), and, finally, nebulous stars—this being the last recognisable stage in the progress to actual stars or suns," observes, "There is something singularly impressive in the ideas suggested by this theory, whether as regards extension of space or duration of time."

On the supposition that the stars are not older than the earth, it would only have been by degrees that their light, according to their various distances, reached it; and, supposing that a human being existed in it at its first creation, he would have seen a sky void of stars; and not till the

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* Estimated as not higher than —60°; but supposed by some to be as low as —80°, and by others even much less.

† Presumably one well-known as the author of various valuable works. He has done a good service in calling attention, in the above cited paper, to the importance of distinguishing between the earlier and more recent conclusions of our great astronomer.

lapse of many years would he have beheld it as we see it now.* From the beautiful passage (Job xxxviii. 7), however, it may be very well inferred that the stars, as well as the angels, had been created prior to the earth. Otherwise, for a long time the striking description (apart from Revelation), by Jean Paul Richter, would have been realised; and the glory of God would but in an inferior degree have been declared by the heavens, and his handywork shown by the firmament.

As the proficient scholar is not always occupied with questions of criticism, but can meet the ordinary reader on common ground in the enjoyment, for its own sake, of such works as those of Shakspeare and Homer; so may the practical observer and the hard-headed calculator sometimes find, away from their especial provinces, the elevating pleasure in the simple survey of the heavens shared with them by the humblest star-gazer. It is good sometimes to read the spangled scroll, nightly unrolled to the view of all, in company with one's fellow men of ordinary intelligence and information. The eye need not always be at the telescope, nor the mind for ever engrossed with equations of condition. Some of us may be able to recall the early zest and eager delight with which we gave our minds to the sublime spectacle, and the transcendent associations of the heavens; or we may remember the eclipse, or the comet, or other phenomenon, which induced our first attachment to astronomy, or revived the flame of an earlier love. Since then we may have been enabled both to see and to know a little more; and it is well if subsequent learning, or mechanical routine, or calculations, familiarity with diagrams and figures, etc., have not in part impaired the freshness of our former feelings. Observatory and library are not essential, that we may listen pleasantly and profitably to the instruction which the star-lit heavens impart in a language intelligible throughout all the world. And with an acquaintance with astronomical facts, probably greater than the psalmist possessed,† our ear may appreciate even more sensibly than his, the sound of the harp-strings which goes out through all the earth. (Ps. xix. 2—4.)

GEORGE J. WALKER.

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* "Du reste, si cette hypothese [of one sole creation], tout à fait contraire au système d'une création primitive et d'une organisation posterieure des corps célestes qui en aurait été l'objet, était exacte, le spectacle que le ciel aurait présenté aux premiers âges du monde, à Adam et à ses descendants, aurait été aussi extraordinaire que singulier. Le premier homme n'aurait pas vu, lors de sa venue sur la terre, une seule étoile au ciel; le soleil, la lune, et les planètes auraient été les seules astres, qu'il y auraient appergus et dont il aurait joui pendant les premières six années. Au delà de cette epoque, les étoiles auraient commencé à apparaître successivement et dans un ordre inverse de leur distance à la terre. La voie lactée n'aurait donc présenté l'aspect, qu'elle offre actuellement, qu'au delà d'un certain nombre de siècles. Enfin aujourd'hui encore des étoiles et des nébuleuses devraient se montrer pour la premiere fois dans le ciel. Il faut l'avouer, de pareilles conséquences sont tout à fait inadmissibles; dès lors on est en droit de rejeter la supposition qui y a donné lieu. La création des étoiles et des nébuleuses a donc precédé la création de l'homme actuel d'un grand nombre de siècles," etc. Marcel de Serres, *De la Creation de la terre et des Corps Celestes*. Paris, 1843. p. 17.

† *Kōkhav*, "star," in Hebrew and Arabic, is derived by Gesenius from the unused root *Khavav*, to roll up; so that its literal meaning is a globe or ball. It is notable that there is only one other word derived from this root in the Hebrew Bible, *Kabbon*, the name of a town in the tribe of Judah. Our own word star (as well as the Greek, *asteer*; the Latin, *aster, astrum, stella*; the Persian, *sitárah*; the Anglo-Saxon, *steorra*; the German, *stern*, etc.) is from the Sanskrit, *târá* (Zend, *stâré*), from the root *stri*, to strew. Compare Milton's, "And sow'd with starrs the heav'n thick as a field."—*Par. Lost*, vii. Conclusions based on etymology are often precarious; and it is only suggested with diffidence that the Hebrew word may possibly indicate a primeval knowledge of the nature of the stars, which was not preserved in the Arian branch of the human race.

DESIDERATA.

Sir,—I have no doubt that the intimation of "Habens" will be received with satisfaction by a considerable number of amateurs, whose zeal exceeds their pecuniary resources. I cannot, however, quite understand how a 10-inch pendulum can be made to beat seconds. I should have fancied that it would have beaten *half* seconds rather. I am familiar with Dent's Dipleidoscope, which scarcely seems to me to obviate the necessity for a cheap form of transit. Of course, if the observer should happen to be on the spot at the precise instant of apparent noon, *and the sun should happen to be shining*, the Dipleidoscope is as elegant and accurate an instrument of the sort, as need be wished for. I confess, however, to a personal feeling as to the desirability of having the 147 *Nautical Almanac* stars to select from; and here the Dipleidoscope certainly can hardly be said to be practically available.

I am sure that Mr. Hind ought to be truly grateful to (that very Earl Russell of Astronomers) Mr. G. J. Walker, for his able advocacy of the "Rest and be thankful" policy, in connection with the publication over which he presides. "The Eclipses of Jupiter's Satellites," says the *Nautical Almanac*, on the very page where Mr. W. quotes, "especially of the first, afford us perhaps the readiest means of determining the longitude." Just so; and yet we are told that this is a "question of . . . . no navigational value;" that we must hope that the errors "are approaching their maximum" (on the principle, I suppose, that "when things get to the worst they are sure to mend"), and so on. If, then, I comprehend Mr. Walker's notion, it is that observations should continue to be made, and suffered to accumulate, at Greenwich, until some Swede, or Frenchman, or German shall take it into his head to utilise them, by calculating fresh tables from them; and that then—but not till then—the *Nautical Almanac* computers are to employ improved data for the emendation of the terribly misleadlng pages which are now published year after year, *malgre* Mr. Walker, without any warning at all. Verily this comes to what I said, about the sole duty of the Superintendent consisting of seeing that his subordinates do not take out the wrong logarithms. Will Mr. Hind himself, in words, accept and defend this definition of his position?

I am, Sir, obediently yours,

3rd August, 1871. EGENS.

Sir,—I feel very sorry for "*Habens*'" knowledge of the requirements of practical astronomical horology, when he recommends such a sidereal clock as he describes, with a 10-inch pendulum and chronometer escapement, and if it is a spring clock, as I suspect it is, the bare idea of recommending it for astronomical purposes is simply absurd. A far superior timekeeper can be had in any old eight-day long cased clock with 40-in. pendulum, driven by a weight, which can be "picked up" in almost any of the second-hand shops for less money than the sum named by "*Habens*," and I would suggest to Mr. Cocks, of Wells-next-the-Sea, that he should give up the idea of such a thing for *astronomical purposes*, for I am convinced that a clock can be produced for 5*l*, with a Graham's dead-beat escapement, which is far easier to make, and therefore cheaper, simpler in its action, not so liable to derangement, and for time-keeping is only rivalled by the more expensive gravity escapement, a compensated pendulum consisting of a deal rod and a leaden bob 14-inches high, and driven by a weight, with maintaining power. The rate of such a clock as this is very little inferior to that of the best Regulator costing 40*l* or 50*l*, or more.

I am, Sir, yours, &c.,

Whitburn, near Sunderland. JOHN G. ALLISON.

THE NAUTICAL ALMANAC.

SIR,—In connection with a letter in your pages wherein Mr. G. J. Walker does me the honour to refer to me by name, I would merely observe that I do not believe that my acquaintance "with the whole history of the perturbations of Uranus, leading to the astonishing discovery of Neptune," would disappoint even his expectations; inasmuch as I have read (for my sins) almost every word, I think, that has ever been published on that subject in the English language. I must add though that the errors in the tabular place of Uranus are perfectly well known, and their direction sufficiently well ascertained to have enabled the computers of the pages of occultations in the *Nautical Almanac* to have introduced a supplementary correction; the more especially as the times given are those about which the occultations *are to be looked out for*. I never dreamed that this correction had not been made, that it was not only shown in what a perfunctory and purely mechanical way the work is done. And again, with regard to Jupiter's Satellites, with reference to the eclipses of which Mr. Walker makes the remarkable assertion that they have "no navigational value." Why the very *Nautical Almanac* prefaces its caution by saying, that "The Eclipses of Jupiter's Satellites, especially of the first, afford us, perhaps, the readiest means of determining the longitude;" and I can certify that the disappearance of the first—and even that of the second—in a telescope of less than two inches in aperture, is a very sharply defined phenomena indeed. There are plenty of nights on board ship upon which these eclipses might be perfectly well observed. They are by no means in this respect like occultations and transits, with regard to which the *Nautical Almanac* goes on very truly to remark. "The instruments required to observe them with anything like precision will preclude the possibility of their ever becoming available at sea;" and therefore to say that they are, *per se*, of "*no* navigational value," is I think, to use a delicate expression, a little exaggeration. That they are valueless *at present* arises from the fact that the predicted Greenwich times of their occurrence are so inaccurate. Looking over a volume of the Greenwich Observations with my friend, the Astronomer Royal, we found, if my memory serves me, more than one instance of Satellite being at least nineteen seconds wrong; and an error of these dimensions would lead to some very funny map making indeed, to say nothing of landing ships on reefs—*et id genus omne*.

I admire the *Nautical Almanac*, I think, quite as much as Mr. Walker himself; but I do not therefore think it perfect, nor conceive that the interests of science will be best served by placing it on a pedestal, and falling down straightway before its image. What defence of its present condition, jesting remarks penned by Professor de Morgan in 1836 constitute I fail to see. If we only carry out your correspondent's principles in their integrity, we may well look forward to bequeathing our national ephemeris intact (blunders and all) to our great-grandchildren. I trust, for the sake of English Astronomy, that a less conservative spirit will prevail. Much as I value the privilege of the acquaintance of "Mr. Micawber," I confess my utter want of faith in his theory of waiting "for something to turn up."

I have the honour to be, Sir,

Your obedient servant,

Forest Lodge, Maresfield, Sussex. WILLIAM NOBLE.
August 9, 1871.

THE NEXT TOTAL SOLAR ECLIPSE.

To the Editor of the *Times.*

SIR,—On the occasion of the eclipse of the sun in December last there were frequent inquiries as to the date of the next solar eclipse which will be total in England. I am not aware that any one was in a position at that time to reply to these queries. It was known from the calculations of Hallaschka and others that during the present century there could be no such eclipse, but with the exception of one or two dates in the ensuing century which had been vaguely assigned, and which have proved to be erroneous, I believe no attempt has been made to ascertain this date, or, at least, that no results of the attempt have been published. The uncertainty thus attaching to the subject, though one of mere curiosity to the present generation, has induced me to undertake a systematic and careful examination of future eclipses with the immediate object of discovering the one in question, and I now forward you the principal results. In this inquiry I have examined accurately many eclipses, in which the central line has not eventually been found to pass over this country, it being very difficult in certain cases to determine, without a rigorous computation, how the tracts would run. For the sake of brevity I shall here allude only to two or three such eclipses.

During the first half of the 20th century I have not found the phenomenon of which I was in search. The eclipses in which the central line approaches nearest to our shores are the following:—That of August 30th, 1905, when entering Spain, near Corunna, and passing over Madrid it launches into the Mediterranean, at Valencia; that of August 21st, 1914, when, meeting the coast of Norway in latitude 64½ degrees, and traversing Nykoping, south of Stockholm, it arrives on Prussian territory, at Memel, whence its course is over the south-west of Russia; that of February 3rd, 1916, which will end at sea, 9½ degrees west of Greenwich, and latitude 49½ degrees; and that of 1925, January 24th, passing off near the Faro Isles. On the 30th June, 1954, indeed, there will occur an eclipse, wherein the zone of totality just touches the British islands; it includes the northernmost of the Shetland group. At the northern extremity of the island of Unst I find the last ray of sunlight disappears at about 0h. 23m. p.m. local time, and the total eclipse continues 2m. 20s. This eclipse of June 30th, 1954, is consequently the first in which totality can be witnessed in any part of the British islands, but to discover an eclipse that will be total in England I have found it necessary to continue the calculations to nearly the close of the same century. Such an eclipse (according to my investigation) will not occur until the 11th of August, 1999, when the circumstances will be nearly as follows:—The central and total eclipse will enter upon the earth's surface in the southern part of the Gulf of Mexico; thence traversing the Atlantic, it meets the English coast at Padstow, in Cornwall, and crossing the south of Devon enters the Channel at Torquay (which will be the most favourable place for observation in this country), and passing over the Eddystone, reaches France about 15 miles east of Dieppe. It will be central and total, with the sun on the meridian some 25 miles south-west of Pesth, and traversing Asia Minor, Persia (at Ispahan), &c., will finally leave the earth's surface in the Bay of Bengal. At Torquay the first contact of limbs or commencement of the eclipse occurs at 8.23 a.m., local mean time, and the last contact at 11.20 a.m. Totality begins at 10h. 0m. 43s., with the sun at an altitude of 48 degrees, and continues 2m. 4s. At Plymouth the duration of total eclipse is 1m. 58s., at Weymouth 1m. 55s. The southern part of the Isle of Wight falls within the northern limit of totality according to my calculation.

The last total solar eclipse, visible in London, occurred on the 3rd of May 1715, and was successfully observed in the metropolis and at many other English stations. In drawing the attention of the Royal Society to this eclipse, Dr. Halley mentioned that since the 20th of March, 1140, he could not find any one that had passed over London, though in the meantime the moon's shadow had frequently crossed other parts of the country. The natural inference from this remark has been that the eclipse of 1140 was total in London, though Halley does not state whether he was guided by historical authority, or by a calculation of the circumstances from the solar and lunar tables. The eclipse is recorded by William of Malmesbury: "While persons were sitting at their meals the darkness became so great that they feared the antient chaos was about to return, and upon going out immediately they perceived several stars about the sun." The Saxon chronicle refers to it in similar terms. I have calculated the particulars of this eclipse, introducing the last value of the secular acceleration of the moon's mean motion, so that my results should very closely represent the circumstances of the phenomenon as it actually occurred. I find the eclipse was not total in London. The central line entered our island at Aberystwith, and passing near Shrewsbury, Stafford, Derby, Nottingham, and Lincoln, reached the German Ocean ten miles south of Saltfleet. The northern limit of the total eclipse passed near Holyhead, Bradford, Leeds, and York, and left England between Filey and Flamborough Head. The southern limit met the coast of Glamorgan below Swansea, and passed over Monmouth, Northampton, Huntingdon, and Norwich: consequently, the nearest approach of the total phase to London was at a point on the borders of Northamptonshire and Bedfordshire. By a special calculation for a point near Stafford, about the centre of the path across England, I find the total eclipse began at 2.36 p.m., local mean time, and that the sun was hidden 3m. 26s., while at an altitude of more than 30 degrees.

The "stars about the sun," remarked by our forefathers, were probably the planets Mercury and Venus, then within a degree from each other, and 10 degrees west of the sun, and possibly the bright stars in the constellations Pegasus and Adromeda, forming what is frequently called, "the square of Pegasus. Mars and Saturn were also at that time within a degree from each other, but very near the western horizon.

It is therefore necessary to look further back than the year 1140 for the total solar eclipse in London next preceding that of 1715. I greatly doubt if, excepting the eclipse of August 11th, 1999, described above, there can be any total solar eclipse visible in England for 250 years from the present time. I am, Sir, your most obedient servant,

Mr. Bishop's Observatory, Twickenham. J. R. HIND.

METEORS.

Dear Sir,—Last evening (Thursday), between the hours of nine and ten, whilst watching the stars with a few friends, we were astonished by seeing no less than 42 falling stars, the majority of which were of considerable size and brilliancy, leaving behind them a trail of light visible some seconds after the disappearance of the star. They nearly all travelled in a southern direction, and started between Cygnus and Hercules. At 10.15 a most brilliant meteor of intense blue colour started from the star γ in Ursa Major, and travelled very slowly till it reached Arcturus, when it suddenly disappeared. The sky was lit up to such a degree that we could see the stars only faintly. At 11.30, a lady friend saw another similar one, which started from the direction of the Dolphin, and travelled to Capricornus. I should be glad to know if these meteors have been noticed elsewhere. The weather the last few days has been most oppressive, and this may account in some way, I suppose, for the appearance of these meteors.

I am, dear Sir, yours obediently,

Pen-y-maes, Hay, S. Wales. HENRY COX.

Several observers have noted a large number of August meteors, which have been this year of considerable frequency and brightness.

DOUBLE STARS.

Sir,—I have the pleasure to send you the results of some recent measures of double stars, in the hope that they may be of interest to some of your readers. The measures were taken with a filar micrometer, attached to my 7¼ inch Alvan Clark Refractor. The column headed N gives the number of nights on which the observations were made.

Star's Name.	Angle of Pos.	Distance.	N.	Epoch.
γ Leonis	112°·82	3″·033	3	1871·38
γ Virginis	159°·79	4″·492	3	1871·38
Σ 1785 (Boötis)...	199°·23	2″·544	3	1871·38
η Coronæ Bor. ...	45°·85	1″·003	5	1871·54
σ Coronæ Bor. ...	195°·34	3″·228	4	1871·53
ζ Herculis	183°·33	1″·021	5	1871·54
Σ 2120 (Herculis)	263°·33	3″·866	3	1871·51
δ Herculis	180°·27	19″·332	3	1871·60
70 Ophiuchi ...	94°·92	4″·301	3	1871·59
61 Cygni	113°·44	19″·167	3	1871·60
ζ Aquarii	333°·61	3″·348	3	1871·61

γ. *Leonis.* Colours, "A," full clear yellow. "B," cool grey green. The decided green tint of "B" always strikes me as peculiar.

γ. *Virginis.* Although I have taken the northern star as my "A," it appears to me rather the less of the two, and of a rather deeper yellow.

Σ. 1785. A binary. The angle increasing—the distance decreasing.

η. *Coronæ Bor.* The distance is, I believe, now decreasing.

σ. Coronæ Bor. I have noted the colours of the components—white or very pale yellow, and clear sky-blue.

ζ. Herculis. The distance was measured on four nights only. The colour of "B," to my eye, is a full deep orange, with almost a brown cast. But for the depth of tint, the measurements would present more difficulty with my aperture, as the small star falls on the first bright ring of the primary.

Σ. 2120. A binary apparently. Mags. "A" 7, "B" 10. The tint of "A" is peculiar. I have noted it "tawny" "or "*pale yellow with rosy flush.*" The colour of "B" is a fine deep clear blue.

δ. Herculis. Colours pale yellow, and ruddy purple.

70 *Ophinchi.* Colours pale yellow, and ruddy lilac.

61 *Cygni.* Both stars orange yellow, the smaller rather deeper in tint than the larger.

I am, Sir, yours faithfully,
GEORGE KNOTT.

Woodcroft Observatory, Cuckfield:
August 16, 1871.

THE GREAT NEBULA OF ETA ARGUS.

Continued from No. 104, page 195.

It is not surprising, then, that Mr. Powell, who appears to have been the first to notice change in the nebula attributed it to his comparatively small telescope, and did not then publish his observations. Amongst his photometric observations of Eta are found the notes about the nebula. "March 23, 1860, nebula about Eta Argus magnificent;" "April 15, 1860, nebula much fainter than formerly;" "March 23, 1860, again, Eta is in a rough sketch placed outside the bright portion of the nebula." And the lemniscate is described as a *channel.* Several entries follow, noting openness of the lemniscate on the south, and greatly diminished brightness of the nebula. "April 4, 1862, Eta Argus beautifully round and clear out of the lemniscate altogether; two patches of nebula with passage between them to the left or preceding."

These were not published till May, 1864 (R.A.S. Notices), after Mr. Abbott had published his observations; to Mr. Abbott is therefore due the credit of first publishing notice of a change in the appearance of the nebula. He had been observing the star for a number of years; but the first observation on the nebula that I can find is dated May 23rd, 1863, and runs thus: "A drawing made of the object Eta Argus quite distinct within the dark space." This was given to the Royal Society of Tasmania on the 9th June, 1863, in a paper on the "Variable star Eta Argus."

A further remark occurs in that paper to this effect: "Comparing the present description with the Cape drawing, it will, I think, appear conclusive that the apparition of the surrounding nebula is also variable. The open space given in the Cape Monograph, and also in the last edition of the outlines, is somewhat in the form of a dumb-bell compressed in the centre, and surrounded with nebula, in the most dense part of which is situated Eta Argus. The appearance of the open space now assumes the form of a crooked billet, wide in the centre and open at both ends, with Eta Argus situated 1′+ within the open space or dark part, and surrounded with an almost innumerable quantity of brilliant stars, some of a blue and some of a ruddy colour."

In May, 1868, some additional observations and a drawing by Mr. Abbott were published in the R. A. S. Notices. Sir John Herschel was very much interested, and carefully compared the drawing with his own in every possible way; he could not, however, identify any of the stars, and could make nothing of the drawing.

In R. A. S. Notices for 1868, he remarks:—"It is much to be wished that some southern observer, furnished with an equatorially mounted telescope, would without further delay set to work and map down the stars visible within this most interesting area, down, at least, to the tenth or eleventh magnitude. Possibly, I may have done Mr. Abbott injustice by assuming that his diagram is intended to convey any delineation at all of the stellar contents of his fields of view; or anything beyond the forms of the nebulous masses as existing among scattered stars. But the question once raised is of the last importance, and must be settled. The question here is not one of minute variations in subordinate features, which may, or may not be attributable to differences of optical power in the instruments used by different observers, as in the case with the nebula in Orion (the only one at all comparable with it in magnitude, complexity, and brightness), but of a total change of form and character—a complete subversion of all the greatest and most striking features, which reminds us more of the capricious changes of form and place of a cloud drifted by the wind, than of anything before witnessed in the sidereal heavens."

In August of the same year Lieutenant Herschel, having gone out to India in charge of one of the Eclipse expeditions, took the opportunity of observing Eta Argus nebula. At his father's request fifty of the principal stars were measured, and identified with stars in the Cape Monograph without difficulty; and several drawings were made of the nebula, showing an enclosed space near Eta, and other features much more like the Cape drawing than Mr. Abbott's. He remarked, also, the increased visibility of the nebula, but said there did not appear to be any very remarkable change in the distribution of the stars or nebula so far as the part immediately around Eta is concerned. R. A. S. Notices for 1869.

In 1869 Mr. Le Seur turned the large Melbourne reflector upon this nebula, and with the speculum, as it then was, could not recognise any nebula immediately round Eta, which was consequently thought to be in the dark space. I have not seen his drawing, and cannot, therefore, say what features he noted; before he left he repolished the speculum, and the telescope now performs much better. With it Mr. M'George has been able to see that Eta is still in the nebula; and in his drawing, which includes only the nebulous mass in which the lemniscate is situated, shows the very dense part near and north of Eta, the enclosed space, and some remarkable minor details at a point about 17 s. preceding and 80″ north of Eta, which are changing rapidly.

It thus appears that, up to the end of 1870, no one had complied with Sir John Herschel's request, but that all the observers had confined their drawings to the nebulous mass in which the lemniscate is situated, and neglected the branches. My first intention was to do the same, for the difficulty of representing such a complicated nebula is very considerable, but I noticed such changes in the branches that I was induced to examine carefully all that is included in the Cape drawing, and to attempt to represent greater part of it.

I determined last year to examine this object, believing that when such a subject is under discussion, all who have the means of furnishing information should do so, and because the Sydney refractor is in defining and light-gathering power nearer to the reflector with which the Cape drawing was made, than any which has since been directed to the object.

From many trials on close double stars I find this instrument quite equal in defining power to the eighteen-inch reflector, but of course not equal to it for revealing minute stars.

Unfortunately in August last Eta Argus was too low down to admit of any satisfactory observations, and I was obliged to defer it to January this year; when I took every favourable opportunity of observing it, and completed the drawing early in March. The observations were taken after the object had attained an altitude of 50° up to 64°.

"Of the 108 stars in my list I was able to identify 104 with those in the Cape list; of the remaining 4—one, No. 25, is very small, and forms part of a triangle close to Eta. In 1834-8 it was probably hidden by the light of Eta. Another, No. 32, is in the dark enclosure, and very small indeed, I am inclined to think it is variable, from comparisons made with four faint ones near Eta. Another, No. 68, must, I think, have appeared since 1834-8, for it is now a conspicuous star, about tenth magnitude, and I am convinced could not have escaped Sir John Herschel's wonderfully accurate survey; and the fourth, No. 92, I have since found is No. 142 H, an error of 10 s. having occurred in recording the right ascension, which should be 135 s. instead of 145 s.

"Of the magnitudes of stars, it is beyond doubt that several of those in the Cape list have changed, and are therefore variable as well as Eta. Mr. Abbott speaks of change but gives no particulars. Lieutenant Herschel also remarked it, but has not given particulars. Mr. Tebbut, whose accurate observations since 1854 on Eta enabled Professor Loomis to correct the period of its variation, noted change in some of the stars in 1868, and, in the recent communication to the R. A. S., notes particularly the changes I have remarked in the largest stars, neither of us being at the time aware of the other's results.

"In 1834-8 No. 71 was sixth magnitude, No. 72 seventh magnitude; now No. 72 is fully half a magnitude larger than No. 71, so that at least one must have changed, and it is remarkable also that the nebula has almost faded from these two stars, as from Eta. No. 105 was sixth magnitude, and No. 101 seventh magnitude; now both are seventh magnitude, and equal to No. 71. Yet all these stars are much brighter than the other seventh magnitude stars of the Cape list, viz., Nos. 1, 2, 291, 300, 51 R=403, 59 R=844, and 1215. I would not, however, lay too much stress upon this until it is known whether all the seventh magnitudes in the Cape list were equal, for, if not, it may be that only Nos. 71 and 105 have changed.

"As to the colours of the stars near Eta, they are, in my estimation, pale indeed compared with κ Crucis; and if in 1865 bright enough to merit Mr. Abbott's remark, 'that although Sir John Hirschel has not overdrawn the beauty of κ Crux, the object Eta Argus is much more superb,' they must have faded wonderfully since, for I only remarked colour in two beside Eta, and both were red. Dr. Wright, who has examined both objects with an 8½-inch Browning reflector, failed to detect anything striking in those near Eta. I have measured several of the double stars, and have not yet found any evidence of angular motion. During my first evening's observation I carefully measured the differences in R.A. and declination of 54 stars from Eta. With a fine parallel wire micrometer, a sheet of paper four times the size of the Cape drawing was taken, and lines drawn on it to the same angular scale; but twice the distance apart upon this, the 54 measured stars were carefully laid down, and the drawing of the nebula then proceeded with. The sheet was kept on a desk near the telescope, and as each outline was traced with the telescope amongst the measured stars, it was laid down on the sheet. When in order to define the positions of particular parts other stars were required, these were measured and the drawing proceeded with. The bright wires on a dark field of the micrometer were also found very useful in guiding the eye, and in three places used to measure the distance of the definite parts from Eta."

IS THE WORLD ROUND OR FLAT?—A SCIENTIFIC WAGER.

SECONDARIES' COURT, GUILDHALL, JULY 27.

(*Before Mr.* KERR).

WALLACE V. HAMPDEN.

This action arising out of a scientific wager, between John Hampden and Alfred Russell Wallace, as to whether the earth is "round or flat," was decided this morning.

Mr. Edward Clarke (barrister) applied under a writ of inquiry for damages issued in this cause, consequent upon judgment going by default against John Hampden. The learned counsel, in a lucid statement, explained that an action which had been brought by Mr. Wallace against Mr. Hampden, for a gross libel that had been published and circulated by the defendant, had been suffered to go by default, and that the plaintiff in consequence sought the damages he was entitled to. Mr. Wallace, he said, was a gentleman of high reputation, and was a member of several learned and scientific societies. He became acquainted with the defendant at the end of last year, through a challenge that he published, offering to stake £500 against £500 of any other scientific man, and to prove that the world was a flat body and not round, as was generally believed to be the case. Finding that some time elapsed before his challenge was noticed, he went further, and stated that scientific men knew they were guilty of an imposition in propounding the *round* theory, and that they were in consequence afraid to take up the challenge. Mr. Wallace subsequently answered the challenge, and lodged his £500 with that of Mr. Hampden's, at Coutts's Bank, to be drawn out and handed over to the party in whose favour the arbitrators decided after the proposed experiments had been gone through. The defendant proposed that the experiments should take place at the Bedford Level. Mr. Wallace was quite content, and the trial was accordingly proceeded with. It was very simple. There were three long staves of equal length. One was placed on the Bedford Canal, another was placed at a distance of three miles, and the third also at the same distance. A telescope was employed, through which it was clearly and unmistakeably perceived that the centre stave was five feet above the line of the telescope, which at once proved that the water was not flat, but oval. Mr. Hampden accordingly expressed himself satisfied, and the money was paid over to Mr. Wallace by Mr. Walsh, of the *Field* newspaper, who had stood as referee. Some time after this Hampden issued a publication of his own, in which he denounced Mr. Wallace as a "liar," a "swindler," and everything that was bad, persisting at the same time that his (Mr. Hampden's) was the correct theory. The libels, which were of the grossest nature, were aggravated by the defendant asserting that Mr. Wallace was afraid to go into court. Mr. Wallace had been eminently forbearing, but, owing to the persistence of Mr. Hampden, was compelled to take the present steps for his protection.

Mr. Wallace was called, and stated that he had experienced a great deal of annoyance in consequence of Mr. Hampden's conduct; and the jury, after a short deliberation, found a verdict of £600 for the plaintiff.

New Planet.—Professor C. H. F. Peters, of the Lichfield Observatory, Hamilton College, announces the discovery of a small planet, the 114th in the group of asteroids, at 3 a.m. on the 25th of July. It was observed in 21 hours 43 minutes right declension, and 10 degrees 12 minutes south declension, having moved in 24 hours 45 seconds in the former co-ordinate, and 4 minutes and 20 seconds toward the south. Its magnitude is estimated between 12 and 13.

The August Meteors.—On Thursday night (Aug. 10th) it was expected that there would be a display of meteors. At midnight the heavens were uniformly dark, and there was no moon visible, but the meteors did not appear. The August meteors, though almost forgotten during the past few years through the attention which has been bestowed upon the November showers, are famous among observers of meteoric astronomy. Professor Alexander Herschel, son of Sir John Herschel, made a discovery in 1866, respecting the August meteors, which serves yet further to enhance the interest of the display. Studying them with a spectroscope, he found that some of them are evaporised during their flight through our air, and that they consist in large part of the vapour of sodium, the chief element of our common salt and soda. Many of the meteors, he tells us, "are nothing else but soda flames, for a great proportion (that is to say, the latter portion) of the time they continue visible." Their condition is then exactly that of the flame of a spirit-lamp, newly-trimmed and largely dosed with a supply of moistened salt; a strange fact truly, and to be had in remembrance as we watch the streaks left by the meteors slowly fading from view. Those soda-flames scarcely accord, perhaps, with our ideas of favourable conditions under which seed-bearing meteorites might plant life, either on our own or on other worlds. Yet ideas scarcely less strange are suggested by the consideration of what must needs happen with the vaporised sodium. As it cools, the vapour becomes sodium dust, and as such it sinks through the air and falls in the lightest of showers on land and sea. For countless ages this has happened. Not the August meteors alone, but upwards of a hundred meteor systems (for so many have been recognised by Heis and Alexander Herschel) have poured their tribute of matter (not sodium alone) from outer space upon this globe, not only during the period of man's existence, but doubtless for ages before he appeared upon the earth. If we have not here the seeds of life conveyed to the earth from interplanetary and interstellar space, we have a supply of many materials which help to support life. So that not only may man, as Humboldt remarked, actually touch (in the aerolite) a non-telluric mass which has for ages traversed space, but he may utilise in his daily work, and even consume in his daily food, the substance of bodies which once travelled beyond the most distant planets, or even circled for ages around other suns than ours.—*Scotsman.*

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN SEPTEMBER, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight.		Objects to be observed.
	° ′		
17	... 138 51·1	...	Picard, A and B Mare Crisium.
18	... 125 43·7	...	Fabricius (*a*), Mesius, Steinheil.
19*	... 112 34·2	...	Theophilus (*b*). Cyrillius, Catharina.
20	... 99 24·9	...	Ariadæus, Silberschlag, Hyginus (*c*).
21†	... 86 17·1	...	Mare Serenitatis (*d*), Sulpicius, Gallus.
22	... 73 11·5	...	Herschel I. (*e*), and region to the N.
23	... 60 9·1	...	Parry, Boupland, Fra Mauro.
24	... 47 11·0	.	Plato, the Hartwell ledge (*f*).
25	... 34 19·3	...	Furrow from Tycho to Bullialdus.
26	... 21 36·6	...	Hippalus craters on the interior.
27	... 9 5 7	...	Three bright craters W. of Hipparchus.
28‡	... —3 10·5	...	Lapeyrouse, Ansgarius, Behaim.
29	...—15 10·0	...	Langrenus, Vendelinus, Petavius.
30	... 26 52·1	...	Fabricius, Janssen, Metius.

For additional objects consult the lists for May and July.

* Summer solstice, N. hemisphere.

† On the 20th and 21st the disc differs but little from a state of mean libration.

‡ Evening terminator.—The objects specified on the 28th, 29th and 30th are seen under the evening illumination.

(*a*) On the S. of Fabricius is a large depression with an elongated central elevation, which stretches from the S. border of Fabricius. It is proposed to name it Janssen.

(*b*) The passage of the morning terminator has lately been favourable for observing sunrise on Theophilus, on May 24th, 1871, the illumination of the two central peaks was well observed.

(*c*) Observations of the great cleft from the E. of Hyginus into the Mare Tranquillitatis are much wanted.

(*d*) Attention is solicited to the three craters N.W. of Linné. Occasionally they are not visible. This was the case on May 26th, 1871, 8·50 to 9·50. Notices of the appearance of surrounding objects are at the same time important.

(*e*) The Rev. T. W. Webb calls attention to a remarkable valley on the N.W. of Herschel I., which is just N. of Ptolemæus. It appears as if *scooped* out by a force not of an eruptive character.

(*f*) A fine delicate hue of light fringing the S.W. border of Plato, visible for about 48 hours.

Errata in No. 104, p. 182, line 15 from the bottom, for *Radamba*, read *Kadamba*. Page 179, line 12 from the end, for *clock seconds*, read *minutes*. Page 183, line 11 from the bottom, for *error*, read *once*. Line 10 from the bottom, for *Associate* read *Asiatic*. Page 186, line 7 from the bottom, for *Vitane* read *Vita e*. Page 194, line 28, for *Aldebran and Leonis*, read *Aldebaran and alpha Leonis*.

New Comet.—Just as we were going to press with our last issue, tidings reached England of the discovery of a New Comet by M. Schiaparelli, at Mailand. It is described as an object of extreme faintness. The following elements are by M. Rumker, of Hamburg.

T	=	1871	Aug. 1·87.
π	=	104	28
Ω	=	209	5
ι	=	79	45
log. q	=	0·00852	

Motion, Retrograde.

During the whole of July it only moved through one hour of R.A., and one degree of Declination. On July 30th, its R.A. was 8h. 49·2m. and $\delta + 59^{\circ}\ 2'$.

ENCKE'S COMET, 1871.

M. Glasenapp, of Pulkowa, has computed the following ephemeris for Encke's comet, now returning to our parts of space.

1871.		R.A. h. m. s.		Decl. o. I.
Sept. 1	...	2 7 29	...	+26 14
2	...	2 7 33	...	26 26
3	...	2 7 33	...	26 39
4	...	2 7 32	...	26 52
5	...	2 7 28	...	27 5
6	...	2 7 22	...	27 17
7	...	2 7 13	...	27 31
8	...	2 7 1	...	27 44
9	...	2 6 46	...	27 57
10	...	2 6 28	...	28 11
11	...	2 6 8	...	28 25
12	...	2 5 44	...	28 39
13	...	2 5 16	...	28 53
14	...	2 4 45	...	29 7
15	...	2 4 10	...	29 21
16	...	2 3 31	...	29 36
17	...	2 2 49	...	29 51
18	...	2 2 2	...	30 6
19	...	2 1 10	...	30 21
20	...	2 0 14	...	30 36
21	...	1 59 13	...	30 52
22	...	1 58 8	...	31 7
23	...	1 56 56	...	31 23
24	...	1 55 39	...	31 39
25	...	1 54 17	...	31 56
26	...	1 52 48	...	32 12
27	...	1 51 13	...	32 29
28	...	1 49 31	...	32 46
29	...	1 47 42	...	32 3
30	...	1 45 45	...	+32 20

OBSERVATIONS FOR SEPTEMBER, 1871.*

MOON'S TERMINATOR.

Selenographic longitudes of the points of the Lunar Equator, and of 60° of northern and southern selenographic latitude, where the sun's centre rises or sets.

Greenwich, midnight		60°N.	0°	60°S.
		Sunset.		
		°	°	°
1871.	Sept. 1	+64·0	+61·5	+58·9
	2	51·8	49·3	46·7
	3	39·7	37·1	34·5
	4	27·5	24·9	22·3
	5	15·3	12·7	+10·1
	6	+3·1	+0·5	−2·1
	7	−9·1	−11·7	−14·3
	8	21·3	23·9	26·5
	9	33·5	36·1	38·8
	10	45·7	48·4	51·0
	11	58·0	60·6	63·2
	12	−70·2	−72·8	−75·5
		Sunrise.		
	16	+55·6	+58·3	+60·9
	17	43·4	46·0	48·7
	18	31·1	33·8	36·5
	19	18·9	21·6	24·3
	20	+6·7	+9·4	+12·0
	21	−5·5	−2·8	−0·1
	22	17·7	15·0	12·3
	23	29·8	27·2	24·5
	24	42·0	39·4	36·7
	25	54·2	51·5	48·9
	26	66·3	63·7	61·1
	27	−78·5	−75·9	−73·2
		Sunset.		
	29	+82·4	+79·8	+77·2
	30	+70·2	+67·6	+63·0

* The computer regrets that the table, p. 199, for August is affected by a constant error (the amount of the moon's rotation for one day). To get the correct valuer, +13·2 must be added to all the longitudes there given.

ASTRONOMICAL OCCURRENCES FOR SEPTEMBER, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Fri	1		Sidereal Time at Mean Noon, 10h. 40m. 50s.			— 7 32·2
Sat	2		Meridian Passage of the Sun, 0m. 21·17s. before Mean Noon	2nd Sh. I.	15 51	7 28·3
Sun	3	13 56	Near approach of B.A.C. 830 (6)			7 24·3
Mon	4			4th Tr. E. 2nd Oc. R. 1st Ec. D.	14 53 15 5 15 38 53	7 20·3
Tues	5			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 46 13 47 15 5 16 6	7 16·4
Wed	6	10 9	☾ Moon's Last Quarter	1st Oc. R.	13 25	7 12·4
Thur	7	16 18 17 18	Occultation of 1 Geminorum (5) Reappearance of ditto			7 8·5
Fri	8	14 2 14 40	Occultation of B. A. C. 2238 (6) Reappearance of ditto			7 4·6
Sat	9	17 13	Conjunction of Moon and Jupiter, 2° 6′ S.	3rd Oc. D. 3rd Oc. R.	13 23 16 44	7 0·7
Sun	10	5 52	Conjunction of Moon and Uranus, 2° 12′ S.			6 56·8
Mon	11			2nd Ec. D.	12 47 34	6 52·9
Tues	12			4th Ec. R. 1st Sh. I. 1st Tr. I. 1st Sh. E.	14 39 20 14 40 15 45 16 58	6 49·0
Wed	13			2nd Tr. E. 1st Oc. R.	12 49 15 23	6 45·1
Thur	14	7 9 10 49	● New Moon Conjunction of Moon and Mercury, 9° 30′ S.	1st Tr. E.	12 34	6 41·2
Fri	15	0 39	Conjunction of Moon and Venus, 14° 27′ S. Illuminated portion of disc of Venus=0·041 ,, Mars=0·901			6 37·3

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sat	16		Sidereal Time at Mean Noon, 11h. 39m. 58·30s. Meridian Passage of the Sun, 5m. 6·13s. before Mean Noon	3rd Ec. D. 3rd Ec. R. 3rd Oc. D.	13 12 2 16 18 2 17 39	6 33·4
Sun	17	6 53 6 10	Occultation of κ Virginis (4½) Inferior Conjunction of Mercury			6 29·6
Mon	18	18 9	Conjunction of Moon and Mars, 3° 54′ S.	2nd Ec. D.	15 23 47	6 25·7
Tues	19	7 44 7 44	Occultation of β 1 Scorpii (2) Occultation of B. A. C., 5330 (5½) Saturn's Ring: Major Axis=38·01″ Minor Axis=16·94″	1st Sh. I. 1st Tr. I.	16 34 17 43	6 21·9
Wed	20	5 12	☽ Moon's First Quarter	2nd Tr. I. 2nd Sh. E. 1st Ec. D. 2nd Tr. E. 1st Oc. R.	12 38 13 7 13 53 58 15 31 17 20	Moon. — 4 54·4
Thur	21	6 14 13 58	Near approach of 7 Sagittarii (6) Conjunction of Moon and Saturn, 1° 14′ N.	1st Tr I. 1st Sh. E. 1st Tr. E.	12 13 13 21 14 32	5 53·5
Fri	22			1st Oc. R.	11 49	6 53·8
Sat	23			3rd Ec. D.	17 10 46	7 53·8
Sun	24	6 35 7 50 10 37 11 46	Occultation of χ Capricorni (6) Reappearance of ditto Occultation of φ Capricorni (5½) Reappearance of ditto			8 51·1
Mon	25	23 3	Inferior Conjunction of Venus			9 45·4
Tues	26					10 36·4
Wed	27	14 36 15 23 16 52	Occultation of 30 Piscium (5) Reappearance of ditto Near approach of 33 Piscium (5)	3rd Tr. I. 2nd Sh I. 3rd Tr. E. 2nd Tr. I. 2nd Sh. E. 1st Ec. D.	11 52 12 49 15 16 15 18 15 41 15 47 13	11 24·4
Thur	28	5 44	○ Full Moon	1st Sh. I 1st Tr. I. 1st Sh. E. 1st Tr. E.	12 57 14 10 15 15 16 29	12 10·2
Fri	29	17 3 17 58	Occultation of Piscium (4½) Reappearance of ditto	2nd Oc. R. 1st Oc. R. 4th Oc. D.	12 41 13 45 17 9	12 54·8
Sat	30					13 39·0

THE PLANETS FOR SEPTEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Right Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	12 3 33	—4 38	8″·6	1 22·5
	15th	11 42 24	2 1½	10″·4	{ 0 6·3 { 23 59·0
Venus ...	1st	12 28 40	—9 57½	45″·5	1 47·5
	15th	12 18 59	11 4	56″·9	0 42·8
Jupiter ...	17th	7 46 34	+21 19½	32″·8	19 59·4
Saturn ...	1st	18 14 18	—22 47	15″·6	7 32·2
	15th	18 14 25	22 49	15″·4	6 37·3
Neptune ...	2nd	1 30 26	+7 36	...	14 43·2
	14th	1 29 31	+7 30	...	13 55·1

Mercury is near the sun, setting before it till the 9th, on which day they will set together; towards the end of the month the planet will rise about an hour and a half before the sun.

Venus sets a short time before the sun till the 7th, and will be visible as a morning star towards the end of the month.

Jupiter for the first half of the month is a morning star, rising in the early morning; after the 17th he will rise before midnight and be visible during the rest of the night.

Saturn is excellently situated for observation, setting at the beginning of the month, four hours and a half after sunset, the interval decreasing to four hours at the end of the month.

SUN.

Greenwich Noon. 1871.	Heliographical longitude		Heliographical latitude	Angle of position of the sun's axis.
	of the apparent centre		of the sun's disc.	
	°		°	°
Sept. 1 ...	89·07	—122 δξ ...	+7·22 N. ...	21·31
2 ...	102·29	—121 ...	·23 ...	21·56
3 ...	115·52	—120 δξ ...	+7·24 ...	21·81
4 ...	128·74	—119 ...	·24 ...	22·05
5 ...	141·96	—118 ...	·25 ...	22·28
6 ...	155·18	—117 ...	·25 ...	22·51
7 ...	168·41	—116 ...	·25 ...	22·74
8 ...	181·63	—115 ...	·25 ...	22·95
9 ...	194·85	—114 ...	·24 ...	23·16
10 ...	208·07	—113 δξ ...	+7·24 ...	23·37
11 ...	221·28	—112 ...	·23 ...	23·57
12 ...	234·50	—111 ...	·22 ...	23·76
13 ...	247·72	—110 ...	·21 ...	23·95
14 ...	260·94	—109 ...	·19 ...	24·13

15	...	274·15	—108	...	·17	...	24·30
16	...	287·37	—107	..	·15	...	24·47
—							
17	...	300 59	—106 δξ	...	+7·13	...	24·64
18	...	313·80	—105	...	·11	...	24·79
19	...	327·02	—104	...	·09	...	24·94
20	...	340·23	—103	...	·06	...	25·08
21	...	353·45	—102	...	·03	...	25·22
22	...	6·66	—101	...	7·00	...	25·35
23	...	19 87	—100	...	6·97	...	25·47
—							
24	...	33·09	—99 δξ	...	+6·93	...	25·59
25	...	46·30	—98	...	6·89	...	25·70
26	...	59·51	—97	...	6·85	...	25·80
27	...	72·73	—96	...	6·81	...	25·90
28	...	85·94	—95	...	6·77	...	25·99
29	...	99·15	—94	...	6·72	...	26·07
30	..	112·36	—93	...	6·67	...	26·14
—							
Oct. 1	...	125·57	—92 δξ	...	+6·62N.	...	26·21

The heliographical longitudes here given are western longitudes, reckoned from an arbitrary first meridian, which is assumed to be directed to the first point of Aries, on January 1st, 1872, and to rotate at the daily rate of $14°{\cdot}2 + \delta\xi$ ($14°{\cdot}2$ being about the average rate of rotation of the spots). The position of the sun's equator is assumed in accordance with Carrington's final determination (*Solar Spots*, p. 244), namely,

Inclination ... 7° 15′ } in reference to the
Node ... ... 73 40 } eclipse of 1850.

VARIABLE STARS.

According to data published by Professors Schoenfeld and Winnecke, the following maxima and minima may be observed during September.

1871.	G. M. T. h	m.						Place of Star for 1855. A. R. h.	m.	s.	Decl. ° ′
Sept. 2	11	8	Algol ...	min.							
5	8	6	Algol ...	—							
7			S Aquilæ ...	—	11	...		20	4	57	+15 11·5
—			R Canis ...	min.	10	...		7	0	44	+10 15·0
8			S Vulpeculæ	max.	8·7	...		19	42	27	+26 55·7
11	13	0	U Coronæ ...	min.	9	...		15	12	17	+32 10·8
13			R Sagittarii	max.	7	...		19	8	11	—19 33·5
14			S Cassiopeæ...	—	7·5	...		1	9	4	+71 50·8
18	10	7	U Coronæ ...	min.	9						
19			S Cygni ...	max.	8·8	...		20	2	28	+57 34·2
—	16	6	Algol ...	min.							
20			U Cancri ...	max.	8·2	...		8	27	28	+19 23·5
22	13	4	Algol ...	min.							
—			R Aurigæ ...	max.	6 6	...		5	5	36	+53 25·0
23			R Ceti ...	—	8·3	...		2	18	38	—0 50·1
24			S Herculis ...	—	6·3	...		16	45	18	+15 11·4
25	8	4	U Coronæ ...	min.	9						
—	10	2	Algol ...	—							
28	7	0	Algol ...	—							
—	15	9	S Cancri ...	—	10·2	...		8	35	39	+19 33·2
29			R Arietis ...	max.	7·5			2	7	53	+24 22·9

Observers of variable stars are requested to watch the changes of magnitude of a new variable in Pegasus, in A. R. 23h. 13 m. 13s. Decl. +8° 7′·5 for 1855. At present it is of about 10m. and is likely soon to increase in brightness, but nothing is yet known of its period.

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To June, 1871.

Ryley, F. B.

To Sept., 1871.

Linwood, Rev. W.
Woodman, T. C.

To Oct., 1871.

Lewis, H. K.

To Dec., 1871.

Bridson, J. R.
Hubbersty, Rev. R. C.
Lee, G.
Sargent, Rev. J. P.
Vines, D.
Weldon, Mrs.

To June, 1872.

Green, Joseph.

August 21, 1871. **Subscriptions after this date in our next.**

Instruments, &c., For Sale or Wanted.

These Notices, which must in all cases be paid for in advance, are inserted at the rate of *One Shilling* for *Twenty Words* or under; half-price only will be charged upon repetition, if no alteration is required. When the address is not given, application may be made to the Editor, with a stamped envelope for reply, without which *no answer can be sent.*—The Notice will be withdrawn should the payment not be renewed.

TO CORRESPONDENTS.

We have received a photograph of Mr. W. Cock's £5 Sidereal Clock.

Several Papers are deferred for want of space.

With this number are given the INDEX AND TITLE to the last Volume of the *Register*.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 106. OCTOBER. 1871.

ON THE STUDY OF SELENOGRAPHY.

By W. R. Birt, F.R.A.S.—No. II.

The subject of our first paper being of a preliminary character, and dealing only with the means of obtaining by the help of the two maps mentioned a general acquaintance with the moon's surface, it may be well in this communication to place before the student a few definite objects of research to which his attention may be profitably directed, and through which it is not unlikely he may contribute to the advancement of our knowledge.

Selenological investigation, having for its ultimate object a knowledge of the physical processes which have been, or still are, in continual or occasional operation within the limits of our satellite, the aim of the scientific selenologist should undoubtedly be directed to obtain an acquaintance with these processes. We are not aware that the study of selenography has ever been seriously taken up with this view; the utmost extent to which it has proceeded is that of delineating the surface and describing its topographical features.

The study of selenology is two-fold; it looks backwards and contemplates those selenographical features, which convey to us information of the operation of forces which have *successively* moulded and modified the surface; it takes cognizance of those appearances observed from time to time, which indicate that forces are still in operation on or near the surface producing "change." The detection of change, with an apprehension of the physical processes by which it is occasioned, is at the present time a subject of great interest.

These two lines of research, although presenting many difficulties, especially to such students as these papers are intended for, are, nevertheless, of sufficient importance to induce us to point out the most efficient means of surmounting them. Of the two, the latter, the detection of change, is by far the more difficult. We shall, therefore, offer a few remarks on the study of the first, which has reference to *successive* eras of formation on the moon's surface, occasionally diverging to notice any modes of observation that may assist in advancing the second.

The two maps already referred to will assist but little in these inquiries, as they are intended chiefly as guides to the principal objects. As, however, observations increase, students will find it advantageous to form indexes, in order that particular features may easily be referred to, and their distinguishing characteristics kept before the mind. When all the referenced objects are well identified on both maps, objects without references should be assiduously sought for.

With a view to become acquainted with features that manifest priority and posteriority of formation, the observer will find it useful to sketch such objects as may arrest his attention, carefully recording on each sketch the date, day of Julian period, &c., as already mentioned. Reference is again made to sketching, because a large number of delineations of various parts of the moon's surface exist with which the observer would do well to compare his own sketches. The practice he has obtained in identifying objects will peculiarly fit him for critically examining the drawings of Schröter in the *Selenotopographische Fragmente*, and we should strongly recommend the observer to identify all the objects in these drawings in the same manner as the larger objects on the maps. It appears to be a most essential element in the advancement of selenography that each separate object on the moon's surface, no matter how small, should be regarded as a separate object of study. If a crater, its exact appearance should be delineated and recorded; should it be near the terminator, not only should its interior shadow be shown, but the extent of the shadow recorded in decimal parts of the diameter of the crater. If a mountain, in addition to its general appearance with its shadow in the drawing, a record especially of the direction of the shadow in reference to surrounding objects should be preserved. The bearing of such studies as these on the questions of activity or change is obvious. The absence of a referenced object in Schröter will excite suspicion that change has taken place since his epoch, and should it occur that after long searching it should be again recovered, an explanation of its absence may be afforded by assuming that forces of some kind have been actively operating during the interval.

It will readily be seen that, to carry out these suggestions effectively, both time and labour of no ordinary amount must be given, and, in addition, we ought to have accurate and minute measurements of the diameters of craters and other objects, including measures for position, &c. When we reflect that no measures of importance have been published since Mädler's time, we need not wonder that selenography has fallen far behind other branches of astronomy. Sir William Thomson, in his address to the British Association, says, "accurate and minute measurement seems to the more scientific imagination a less lofty and dignified work than looking for something new, but nearly all the grandest discoveries of science have been but the rewards of accurate measurement and patient long-continued labour in the minute sifting of numerical results." Professor Tait, in his opening address to the Physical Section, exhorts mathematicians to be up and doing. "'A little folding of the hands to sleep,'" in chuckling satisfaction at what has been achieved of late years by our great experimenters, and we shall be left hopelessly behind. The sad fate of Newton's successors ought to be a warning to us. Trusting to what he had done, they allowed mathematical science almost to die out in this country." May we not say that, trusting to what Mädler has done, astronomers, with but few exceptions, have allowed selenography so to decline, that but comparatively little interest is manifested in it at present.

The division of labour appears to be the most legitimate mode of meeting this state of things, while the aspect of affairs is no doubt gloomy, inasmuch as lunar physics are but little thought of in some quarters. We have a small band of devoted selenographers who, by the most patient and unremitting attention, are helping on the work; and, while these observers give the greatest share of their labours to elucidating the question of present activity and its connection with change, there is great room for others, if so disposed, to attack the subject of former activity, the evidences of which are scattered broadcast over the moon's surface.

The establishment of a system of correspondence between selenographers (if published, so much the better) would tend greatly to increase the interest in the general subject; for example, let a formation be chosen for observation of which records exist in Schröter, Lohrmann, Beer, and Mädler, the areas of the British Association map, or the Mare Serenitatis; a comparison of the moon at the telescope with each of the above-named authorities could not fail of producing valuable results; something would be elicited illustrative either of former or present activity; the condition of the same object could be traced from the epoch of Schröter onwards; and, while one or two differences amongst the authorities above-named might be referred to errors of delineation, still, as these supposed errors became numerous, a discussion of them *inter se* might throw such light upon them, as to indicate the high probability of their having been faithful records.

With regard to successive eras of formation, we may remark that a few notices occur in the writings of older selenographers; indeed, the fact is not disputed by modern writers; it is, perhaps, the mode in which it is put by two authorities that attention should be drawn to it. A complete history of all the changes that any given formation has passed through, as evidenced by the mountains, craters, faults, fissures, and markings on and around it, would go far, not only to indicate the nature of the forces that have operated in past selenological time, but would throw light on any possible manifestations of the same forces at the present epoch. To accomplish this, earnest co-operation is essential; this has been afforded, and we hope at no very distant day to present to astronomers such a history, materials having been furnished by selenographers who have steadily and unremittingly observed a well-known formation for some years past.

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*THE FALLING STARS.**

This year, also, in the night of the 10th August, we have had the usual rain of falling stars, called *Perseids*, because they traverse the heavens in lines which all meet in one point, or *radiant*, in the constellation of Perseus. This rain has, however, been rather limited; since from 9½h. in the evening until 2h. after midnight only 160 falling stars were seen, of which only 26 were moderately large. Only one bolide of considerable size was seen in the night of the 10th—11th August, at 2h. 20m. It started from the centre of the constellation Perseus, and went to the centre of Andromeda, moving in a zig-zag line, and changed colour, taking in succession the various tints of the rainbow. Last night also (11th August), falling stars were observed, almost in the same number as in the night of the 10th.

The details of our observations will appear in some scientific magazine, as they can interest those only who systematically cultivate science; meanwhile, we are asked by not a few of those, who however occupied with other studies, nevertheless feel the want and even necessity (such is the bond that unites all the branches of human knowledge) of knowing, at least, some general principles of the physical sciences, why every year observations are made of these falling stars, now that it is known to every one that it is a phenomenon of annual occurrence? We answer, that accurate observations of natural phenomena, even of the most com-

* By Professor Donati, in the "*Italia Nuova*," August 15th.

mon, are always desirable; as sooner or later they always serve some useful or entertaining object. But, moreover, in this case, notwithstanding that the phenomenon is periodically reproduced, it is not manifested constantly with the same intensity; since, in some years, very many falling stars are seen in August—in others, on the contrary, very few. Why is this? By researches made in late years by many learned men, and in particular by Professor Schiapparelli, it results that the so-called falling stars are unquestionably nothing but small corpuscules, found scattered and wandering throughout the infinite space of the universe; and which, when they approach the earth, are attracted by it and forced to run down with immense velocity within our atmosphere, in the which, by reason of the excessive friction which they undergo, they are inflamed and dissipated. This, for the most part, takes place in the elevated regions of the atmosphere; and then we have the phenomenon of the *falling stars*, properly so called. If, however, those corpuscules have a mass so great that all their matter cannot be dissipated in a very few moments, they pursue their course to lower regions of the atmosphere, and in this case we have the phenomenon of the *bolides*. If occasionally the corpuscules are sufficiently massive to last so long as to reach the earth, then we have the phenomenon of *aeroliths*; that is, of those *air-stones*, which have given origin to so many tales and so many false hypotheses.

These corpuscules, like the stars, are scattered throughout all space; and, in fact, no night passes in which, if the heavens be attentively observed for a certain time, some will not be perceived, under the form of falling stars; but just like the stars, which form here and there diverse agglomerations, of which the greatest we see is the *Milky Way*, do these cosmical corpuscules also form agglomerations in various parts, in relation to the which depends the manner in which the phenomena of the falling stars appear to us. If those corpuscules were not in their nature dark, or if, at least, they were sufficiently large and near to reflect sensibly to us the solar light, it would have been most easy to study their distribution; but since they manifest themselves to us as celestial bodies only in the moment in which they become, in reality, terrestrial, science has been obliged to collect a large number of facts, and to resolve also many very intricate geometrical problems, before it succeeded in explaining physically and mathematically the phenomenon of the falling stars.

Let us see how it explains the phenomenon of the falling stars of the 10th August. There exists around the sun a great ring (*armilla*), like a large skein (*matassa*) continuous, formed of very minute bodies, which without going out of it revolve round the sun in the interval of about 108 years, in virtue of the attractive force exercised on them by the sun itself. This ring, or skein, has a fixed position in space; or, at least, there are not yet facts enough ascertained to show that it changes its place. And that position is such, that when the earth in its annual revolution is found in that point of its orbit which corresponds to the 10th August, it is found at the same time in the neighbourhood of the said ring, round which, just as in a skein, there issue irregularly here and there a number of threads, which are formed by some of the corpuscules which constitute in their aggregate the ring itself. Then the earth, by reason of its attractive force, withdraws from the solar action those corpuscules of the the threads which are nearest to it, and draws them to itself, and thus we have the phenomenon of the falling stars; whilst the thick, that is to say the more compact portion of the ring, continues its course round the sun, and remains invisible to us. And, because the ring is not everywhere of the same thickness, but, like an entangled skein, has in some points swellings, lumps, or knots, it happens that not every year our planet draws to itself the same number of little bodies; but more or less of them, according as it approaches more or less dense parts of the ring. Observations have shown that a great maximum in the number of the August falling stars occurs in about 108 years; and hence, it has been inferred that the corpuscular ring to which the August falling stars belong, however continuous—inasmuch as the phenomenon is observed every year in that month—has nevertheless in its extension a great condensation of corpuscules; and, since this maximum condensation returns at the end of 108 years to that point of space which the earth occupies on the 10th August, it follows that the ring completes its revolution round the sun in the above period of time.

Besides the falling stars of August, we have also those which are seen between the 13th and 14th November, which are called *Leonids*, because they describe lines which have all a point of concourse, or *radiant*, in the constellation of the Lion. But the phenomenon of November is very far from being so regular and constant as that of August. In fact, it has been observed that the maximum number of the falling stars of November happens about every period of 33 years, and that in the intermediate years, the number is very far inferior to that maximum. This leads to the conclusion that the falling stars of November, in place of being derived from a ring continuous and similar to that from which the August meteors have their origin, are rather derived from a band, nearly discontinuous, resembling one of those finger-rings in which, in comparison with the largeness of the gem, the rest of the circle is hardly noticeable. It appears, then, that those corpuscules are found for the most part agglomerated only in a small space, and that they form a kind of heap or assemblage, revolving round the sun in 33 years, and passing near that point in space which the earth occupies on the 13th November every year.

Besides the falling stars of August and November, there are also other secondary systems of these bodies, the periods of which are sufficiently well determined, but of which this is not the place to speak.

In the next place, it is a most important fact that there are some comets which move in space in the same orbits in which revolve the little bodies that generate the falling stars. It has, in fact, been recognised that the third comet which appeared in 1862 moves in an orbit identical with that in which the corpuscules revolve which occasion the August meteors; and that the first comet which appeared in 1866 has an orbit identical with that of the corpuscules which generate the falling stars of November. It appears, then, that comets are as it were the elder sisters of those little bodies which give rise to the falling stars, when they are turned out of their normal course and come to be immerged in our atmosphere. Comets, notwithstanding that they are dark, and continue always very far from the earth, are yet visible, because they are sufficiently large and condensed to reflect not a small quantity of the light which they receive from the sun, which the corpuscules above-mentioned cannot do, because they are too small and scattered.

From the little that has been thus far said, it appears clear that science has already done much for the investigation of the nature of the falling stars and comets; nevertheless, there remain not a few investigations to make, and very many facts to be explained, even in this vast branch of natural philosophy; in the which, almost continually, opportunities are offered to astronomers for undertaking patient observations, which, barren in appearance, yet always lead to the knowledge of new truths. At this time, for example, there is seen on our horizon a very small comet that was discovered at Milan by the Sig. Tempel, which has so feeble a light, that even with our very powerful telescope, by Amici, we have only been able to observe it with difficulty; still we have followed it with all the care and regularity possible, for the very reason that from the position it occupies on the celestial vault, and the extreme faintness of its light, this comet can only be observed in very few observatories. Small, however, as it is, it may be of great importance to science, since it is likely that it is the same comet which appeared in 1827. There is another small comet which will be observable before long; that is, the comet called Encke's, which, as is known, returns every three and a half years, and which is continually drawing nearer to the sun, into which sooner or later it must fall. This comet, by the constant diminution of its distance from the sun, has revealed to us the existence, and may hereafter bring us acquainted with the disposition and structure, of that *cosmical atmosphere*, which is called *æther;* about which, hitherto, so little is known, although so much is continually said of it in all the physical sciences.

Royal Observatory of Florence:
August 12th, 1871.

THE GREAT NEBULA OF ETA ARGUS.

(Concluded from page 215).

"The drawing was then reduced to its present size with proportional compasses, and afterwards compared with the object, under different states of the atmosphere, with moon and without moon, and corrected until it was deemed a faithful representation of it as seen now.

"On comparing this with the Cape monograph, startling differences are found, not so great near Eta as some observers have thought, but far greater than any which astronomers have before witnessed. In the nebula in Orion the changes are so small as to be with difficulty made out; but here the densest part in 1834-8 is now one of the faintest, while close to this another part of peculiar form has become the brightest patch in the nebula.

"Examining it more in detail, it is seen that the mass in which the lemniscate (or dark enclosed space) is situated is in general outline very much the same as it was thirty years since, and in some of its marked features exactly the same; as for instance, the definite outline beginning at 70 s.—240," and running still exactly as Sir John Herschel has described it amongst some small stars, but round the border of the lemniscate great changes in the relative brightness of the different parts of the outline have taken place, and some slight changes in the outline itself, the greatest being at 17 s.—100" where one point now occupies the place of two in the Cape drawing; and it is remarkable that it is just at this point that the large Melbourne reflector reveals rapid change at the present time; the nebula also seems much brighter at this point than it was in 1834-8, judging from the parts which appear unchanged.

"It is, however, at the south end and following side that the most remarkable change has taken place: this end and half the side have now become so faint, that with small telescopes no nebula is seen at all; while the other half of the same side has so much increased in brightness that it is now the most marked feature of the nebula, its outline on the preceding and north sides being very like that in the Cape drawing, while the following and south side of it form a curved line which seems faintly indicated in the same drawing. This is a very curious feature and seems to indicate that this is a nebula seen upon the fainter one. It has evidently become much brighter since 1834-8, and is, I think, one of the principal causes of the increased visibility of the nebula being now always more conspicuous than any other part, and visible when they are lost in twilight or haze. In other respects this drawing seems to represent the same object as the Cape monograph, allowing for difference in the telescopes. The star No. 11 (664 H) is just in the edge of the nebula; and about midway between it and Eta is another star about fifteenth magnitude, not in this drawing or in the Cape list.

"Passing now to the branches, we find changes even more surprising than those already noted; I think without a parallel, and pointing to the urgent necessity for carefully recorded observations of all such objects, and if this square degree is to be taken as a sample, promising more discoveries than have ever before been made in so small a space. At the spot + 40 sec. + 600 min. in the Cape drawing is a mass of nebula forming one of its marked features, and particularly described by Sir John Herschel as so situated with regard to certain stars, that the least change would be apparent. Of this not a vestage is now to be seen; yet it was about as dense as that near Eta. Again, about star No. 100 (1103 H) there was a decided condensation of nebula, now it is not to be seen; and of the well-marked streams from stars Nos. 71 and 72, now nothing can be seen but a faint undefined haze, much fainter than that now about Eta. The nebulous branch, also, which terminated 150 sec. before Eta in the same parallel, now extends to over 200 sec. Some changes have, I think, taken place also at + 40 sec. + 1200 min.; but all is there so faint that I am doubtful about it. The oval shown in the north extreme of the Cape drawing is still the same, limited by the stars as it was then. In it I saw three minute stars; Sir John Herschel records four seen with his reflector.

"Taken as a whole, this object must have increased in brightness very much, for it can now be seen in full-moonlight; and in 1834-8 it was at all times invisible to the naked eye. This fact, and the great similarity in outline between the Sydney and the Cape drawing, have inclined me to think, that if the same reflector could again be turned to this object, the lemniscate would be found very little altered, and the apparent difference quite as much, perhaps more, in the increase of light at two points before indicated, as in the loss of light in other parts.

"Still a great change has taken place, and since Eta has only a very small proper motion, which with one exception appears to be common to the stars and nebulæ near it, and that the latter shows no signs of resolvability, even in the large Melbourne reflector; but, as far as the spectroscope has yet been applied, is gas, like the great nebulæ in Orion. I am inclined to think that the mass surrounding Eta and the leminiscate is in reality two or more nebulæ in visual superposition; and that the force, whatever it may be which renders them luminous, is decreasing in that in which Eta is seen, and increasing in that part north of Eta whose peculiarity in form was before remarked, for it seems more reasonable than to suppose that large nebulæ have had the necessary angular motion to bring them visually over other parts. A motion, be it remembered, so large that even astronomy presents us with no parallel; while, on the other hand, it is known that several nebulæ have faded in a few years so much that they could not be seen without the aid of large telescopes. Of this character was one discovered by Mr. Hind in 1852, it was observed rather bright by D'Arrest in 1853, by M. Auwers in 1858 fainter, and in 1861 he could not find it with the same telescope, $4\frac{1}{3}$-inch, or with a 6-inch. With the large refractor at Pulkowa it was seen but very faint indeed. Another one in Coma Berenices, discovered by Sir William Herschel, was missed in

1862. D'Arrest having found two nebulæ which he thought new, Sir John Herschel pointed out that his father found three in the same place; subsequently M. Foucalt's large reflector revealed the missing object, but it was very faint indeed.

"The extent of these faded nebulæ near Eta, if assumed to be at the distance of the nearest known fixed star (20 millions, 3¼ years' journey for light), is so great that space for thousands of solar systems such as ours would be found without the orbits of the most distant members overlapping; yet all has to our senses ceased to be in about 30 years—perhaps had done so when the Cape drawing was made, with light which may have been still streaming in from space."

List of Recorded Magnitudes of Eta Argus

Year.	Magnitude.	Observer.
1677	4	Halley.
1751	2	Lacaille.
1811	4	Burchell.
to 1815	4	Burchell.
1822	2	Fellows
1826	2	Brisbane.
1827	1	Burchell.
1831	2	Taylor.
1832	2	Taylor.
(made in same year	2	by Johnson)
1833	2	Taylor.
1834	1·4	Herschel.
to 1837	1.4	Herschel.
1838	0.5	Herschel.
1842	1	Maclear.
1843	0.5	Maclear.
1845	1	Jacob.
1850	1	Gillis.
1854	1	Tebbutt.
(made in same year	1.2	by Powell.)
1856	1.5	Powell.
(made in same year	1.0	by Abbott.)
1858	2.3	Powell.
(made in same year	2.1	by Abbott).
1859	3.1	Powell.
(made in same year	2.7	by Abbott.)
1860	3.0	Tebbutt.
(made in same year	3.3	by Powell, and
	3.1	by Abbott.)
1861	3.6	Powell.
(made in same year	4.2	by Abbott.)
1862	4.9	Tebbutt.
(made in same year	4.9	by Abbott.
1863	5.1	Tebbutt.
(made in same year	6.0	by Abbott, and
	5.0	by Ellery.)
1864	5.2	Tebbutt.
1865	5.2	Tebbutt.
1866	5.8	Tebbutt.
1867	6.0	Tebbutt.
1868	6.0	Tebbutt.
1871	7.0	Russell.

"Mr. Russell was warmly applauded at the close of his remarks, and a vote of thanks for the paper was carried."

CORRESBONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

MARS IN 1871.

In the months of March, April, and May, this somewhat difficult object was carefully watched, and some score of drawings made. The subjoined notes will, perhaps, convey a tolerably clear idea of the, principal features observed on the disc.

March 23rd, 12h. The Northern snow-cap was large and bright. A large balloon-shaped figure lay along the diameter from north to south, its widest end being the southern. Above this, and encircling the southern pole, was a dark broad band. Projecting from this band towards the north were three dark forms, like claws, the two western ones having the points turned to the west, and the eastern claw having its point turned to the east.

The broad ends of these objects, on reaching the band, did not blend with it, but were much darker than it, and seemed to spring from the central line of the band. The pointed northern end of the balloon was cut off from the polar snow by a line of light.

April 6th, 11h. A dark broad band lay round the south pole, but on approaching the south-west edge of the disc it swept along the western limb, but stopped short of the northern snow-cap. To the east of its northern end, and lying south of the snow, lay a triangular dark patch.

A large circular bright spot lay near the curve, just described; it was on its eastern side, and near the middle portion of the curve.

April 4th, 11h. The northern and southern snows were well seen; the latter being much the smaller, and less distinct of the two.

A dark band surrounded the south pole; near its western extremity it had a dark spot in it. Close to this broad dark band was the base of a large triangular dark object. The base was parallel to the southern band; the apex of the triangle extended to the north beyond the centre of the disc. To the west of the apex, but near it, was seen a small narrow dark patch, lying east and west. Another dark spot lay some distance to the east.

Other minor features were seen, but none deserving of remark, except a very bright spot on the south-west edge of the disc, not far from the southern snow-cap. It lay just within the dark southern band, and at its western end. It closely resembled the snow about the south pole in shape and size.

Owing to the extreme unsteadiness of the air and the bad weather, no measurements could be obtained; and, therefore, no engravings are herewith sent. The drawings have, however, been lithographed as rough pictorial memoranda for future reference.

Mr. Birmingham, with his 4½ inch refractor, saw all the principal features observed here, and also one or two not observed at this place.

EDWARD CROSSLEY, F.R.A.S.
JOSEPH GLEDHILL, F.G.S.

Park Road Observatory, Halifax:
September 11th, 1871.

THE LUNAR CRATER LINNÉ.

Sir,—In my letter of March 3, 1871, see *ante*, No. 100, for April, p. 82, I quoted an observation of Linné, the object having been seen as a slight depression. On the 24th of June, 1871, 9.0 to 9.30. G.M.T., I observed Linné as a white spot, somewhat faint. The wind was occasionally troublesome, but at times the definition was remarkably superb; when Linné assumed the aspect of a *very shallow crater*, about the size of Sulpicius Gallus, which was exceedingly well seen. Bessel was also very distinct, and the shadow of the ridge from Sulpicius Gallus to Linné well marked. Posidonius γ presented its well-known mountain character, and on it, as well as on Linné, the white cloud seen under a later illumination was not apparent. The difference in aspect between Bessel and Sulpicius Gallus on the one hand, and Linné on the other, was very marked. Bessel and Sulpicius Gallus being seen distinctly as craters. The three craters N.W. of Linné were not seen, while the dark western border of the Mare Serenitatis was very distinct, and the line of demarcation between it and the lighter and more central portions of the Mare quite arrested the attention. I may just remark that nothing has reached me bearing on the errors of Lohrmann, Beer, and Mädler, and Schmidt. Are we without evidence to conclude that their drawings of Linné were inaccurate?

Yours truly,

Walthamstow: August 12, 1871. W. R. BIRT.

P.S.—In an article entitled "St. Lawrence's Tears," in the *Daily Telegraph* of August 11, M. Mennier's view of the clefts on the moon's surface is quoted. "He sees in the geological 'faults' of our globe the symptoms of such a disruption, and a more palpable manifestation of it is to be witnessed upon the moon, whose crust is scored by deep fissures a mile wide and hundreds of miles in length, which fissures, there is some reason to believe, are increasing in extent and number."

DESIDERATA.

Sir,—"Egens" and Captain Noble have mis-read my words, "of no navigational value," which have nothing to do with the Satellites of Jupiter, but only refer to Uranus. I should have imagined the paragraph was clear enough, but as more than one person has misapprehended it, it is as well to point out their mistake. I should fancy 19 seconds is rather an exceptional amount for the errors in the eclipses of the 1st Satellite; but even, otherwise, he would be a poor navigator, who should land his ships on a reef, after getting his longitude as near as that. Any thing under a quarter of a degree should lead him to be "thankful," if not, "to rest." At the very meeting of the R.A.S., when Capt. Noble is reported to have made the indiscriminating onslaught on the Nautical Almanac, which partly drew forth my letter, both the Astronomer Royal and M. Dunkin testified to the general accuracy of the times of the eclipses of the 1st and 2nd Satellites. (See Register, pp. 131, 132.) As far as my own experience goes, making allowance for the greater uncertainty when Jupiter is low down in the heavens, or near the sun, and when the phenomenon occurs very near the planet, I can by no means agree with Capt. Noble, that these phenomena are "valueless at present." Upon reflection, perhaps, he would admit *this* to be "exaggeration," and I much question his idea (if I understand him aright), that the Tables of Uranus admit of being touched up in their actual condition. I find the

Astronomer Royal declares that "Tables could not be corrected by bits, but must be done throughout at once :" (Register, p. 132.) and, the gist of my difference with your two correspondents is, that we cannot expect so great a work as this to be performed either at Greenwich, or in the office of the Nautical Almanac.

I only add, that I demur to the fairness of some of the remarks in both the letters before me ; but, acquitting their writers of being intentionally unfair, and wishing them many years of health and facilities for cultivating the noble science we are all agreed in devotion to,

I remain, yours, &c.,

Teignmouth : Sept. 1871. GEORGE J. WALKER.

SIR,—I think it would be very ungracious and ungrateful on my part, were I not to hasten to acknowledge my deep sense of obligation for the very kind and considerate commiseration, expressed by your Whitburn correspondent, for my "knowledge" (or, rather, I should fancy lack of it) "of the requirements of practical astronomical horology." But, I regret, the information conveyed in his communication is not much calculated to improve or extend it. I should have conceived it had been already generally well known that a common eight-day clock could very readily be rated and set to sidereal time, had not Mr. Allinson recommended it rather in the light of a novelty. Chambers, in his "Description of Astronomy," page 703, says—"A chronometer, or well made clock, set to sidereal time is needed. It is by no means necessary in a general way that this should be an expensive or highly exact instrument. An ordinary good parlour timepiece, costing from *6l* to *10l*, will meet all the requirements of the amateur ;" and, I think I can even, in my state of lamentable ignorance suggest an amendment on the "old eight-day long cased clock, with 40 inch pendulum," by converting the said clock into a "three-quarter length," by hanging the weights by three strings instead of two, the lower pulley being let into the weight instead of being placed some inches above it. The case may then be cut off to the length required for a seconds pendulum. Mr. Allinson appears to ignore altogether, or, at any rate, not to appreciate, the comfort and convenience afforded by having a clock fitted with a well-divided and clearly figured sidereal dial, a clock beating seconds in a loud and distinct manner, and striking the minutes; also, the small size of the clock, which enables it to be placed in small gazebos or observatories, on an isolated brick or stone pier, perfectly free from vibration, as such clocks should ever be, and as steady as the equatorial itself. "The bare idea" of the clock I mentioned in my reply to the query of "Egens" being "a spring clock" really is not so "simply absurd" as Mr. Allinson "suspects." The necessity for the correct performance of marine chronometers is universally admitted, and magnificent eight-day instruments are now produced by our leading makers, which vie in accuracy of time-keeping with those requiring to be wound up every 24 or 48 hours, and yet in these marvellously exact instruments the motive-power is a spring. Drawing-room and library clocks of unimpeachable veracity are all, or nearly all, driven by springs, and some of the most beautiful specimens of the mechanical skill of the "old masters" in horology are similarly actuated. The new *5l* sidereal clock was never intended to supersede the costly and exquisitely manufactured Observatory Sidereal Regulator of the professional astronomer, but designed simply as a trustworthy and efficient adjutor to the amateur astronomer. In fact, it must be regarded in the same light as the cheap and excellent educational, optical, and other scientific instruments now offered by enterprising firms to the intellectual public, and we must remember that many and great discoveries have been made, and good services rendered to science, by men provided with very modest instrumental means. In reply to the doubt expressed by "Egens" of the capability of a 10-in. pendulum to beat seconds, I beg to assure him that, with Mr. Cock's arrangement of the chronometer escapement, it does so most accurately. I merely recommend the Dipleidoscope to time the clock by, not as a substitute for the Transit, a cheap and reliable form of which I hope soon to see advertised.

I am, Sir, yours most obediently,
HABENS.

AUGUST METEORS.

SIR,—The annual display of August meteors this year was unusually fine, and far surpassed, as to number and brilliancy, the shower of last year. The weather was all that could be desired, clear, cool, and nearly destitute of moonlight.

In the north the Aurora held sway, but was confined to a steady light near the horizon, with only now and then a few streamers.

During the night of the 9th, from 12 m until 2 a.m., there were seen by two observers, 142; 72 the first hour, and 70 the last. 8 were of the 1st magnitude, 16 the 2nd, 28 the 3rd, 30 the 4th, and 60 the 5th.

On the eve of the 10th, there were seen 567 in 5 hours, from 10 p.m. until 3 a.m., as follows:

Hour.	1st Mag.	2nd.	3rd.	4th.	5th.	Total.
10 p.m. to 11 p.m. ...	3	3	9	14	20	49
11 p.m. to 12 m. ...	14	15	22	19	42	112
12 m. to 1 a.m. ...	12	12	13	27	58	122
1 a.m. to 2 a.m. ...	11	10	22	21	67	131
2 a.m. to 3 a.m. ...	12	12	26	35	68	153
	52	52	92	116	255	567

A grand total for the two evenings of 709. Last year, three observers, 4 hours, counted 302. The first magnitude ones were all more or less brilliant, with trails lasting from 1″ to 9″. The colours were orange and violet, and the radiating point seemed to be from Algol in Perseus.

Of the most remarkable ones, one of the 1st magnitude separated after shooting 10″, and formed two, and continued on for 20° more; and one of the 2nd magnitude was 8″ in traversing a space of 20°. As to size, the most brilliant ones were about the apparent magnitude of *Venus*.

If favourable, the 13th and 14th of November, an observation will be taken all night, when a more interesting account will, no doubt, be recorded, as in 1868 over 5,000 were counted by three observers.

E. F. TANGER, S.A.S.
Boston: Aug. 14, 1871. H. E. STEVENS, S.A.S.

OLD STAR MAPS.

SIR,—Can any of your correspondents give the title of a folio book, published somewhere about 1600, in which the constellations are arranged with Christian figures instead of Lyra, Bootis, &c. ?

I think it was done by the Jesuits. I should much like to know where a copy is to be seen. S. S.

NEPTUNE.

SIR,—Neptune is now near the double star 123, Piscium, which Webb calls a "fine test, requiring beautiful weather." I have seen it well with my $3\frac{3}{4}$-in. aperture achromatic, and 175 power. Should any readers of the *Astronomical Register* wish for a diagram of the small stars near Neptune, in order to make sure of him, I will forward it on application enclosing a postage stamp.

Yours, &c.,

GEORGE J. WALKER.

Teignmouth, Devon: Sept. 12, 1871.

OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS TO JULY 31, 1871.

Solar Spots.—Mr. T. W. Backhouse, of Sunderland, obtained the following measurements of a large spot that was perceptible on the sun:—On the 12th, at 9h. 12m. a.m., the umbra was 20,000 miles long; on the 15th, at 9h. 15m., a.m., the penumbra was 36,000 miles in length; on the 18th, at 7h. 45m., a.m., the dimensions of the penumbra and umbra were 37,000 miles and 22,500 miles respectively. At this time, the width of the umbra was 14,500 miles. On the 20th the spot had increased in magnitude, the penumbra being 41,000 miles long, while the umbra was equal to 27,500 miles. It had decreased in size on the 22nd. Mr. Backhouse remarks that it was the largest umbra he ever saw.

Comets I. and II., 1871.—Mr. John Birmingham, of Tuam, writes as follows:—I had several observations of Comet I. from April 22 to May 8, but under very unfavourable circumstances, caused by the state of the atmosphere and strong moonlight and twilight. Still, notwithstanding its faintness, a nucleus was easily detected, and the comet seemed in general to present a granulated appearance. On April 22, it was not visible in the finder, but bore magnifying up to 126 very well. There was a slight elongation in the normal direction of a tail. By the best measurements that I was able to apply, the comet seemed always slightly in advance of the position computed by Pechüle. On July 17, at 12h. 15m., Dublin mean time, I first found Comet II., the cloudy weather having rendered a previous search ineffectual. This comet was of extreme faintness, and, without the sharpest attention, it might easily pass unnoticed across the field. When first observed, it was in contact with a small star, not identified, from which it gradually detached, and its position seemed to agree with Pechüle's calculation. It was best seen with 56 and 99; and, with the latter, after intent gazing, the momentary flickerings of minute points in its misty form could be caught at instants of good definition. This so strongly suggested the appearance of a nearly resolvable cluster, that I was not satisfied with the comet's identity until I perceived its motion. Previous to this observation, I had not read the description of the object by Herr Tempel, the discoverer; but, subsequently, I was pleased to see his allusion to its appearance as if sprinkled towards the middle with little stars. If the light of the comet is sufficient, I shall not be surprised to hear of its giving indications of a continuous spectrum, in addition to the usual bright lines." Mr. Charles Hill, of Bristol, also observed Comet II. with his 8½-inch equatorially mounted reflector. He examined it for some time during the night of July 18—19, but it was so exceedingly faint that it could only, with great difficulty, be detected.

Venus.—Mr. Henry Ormesher, of Manchester, has frequently observed this planet during the last few months. He has on several occasions succeeded in detecting the dark markings. He says:—"May 10, 8h.—The markings were clear and well defined, and reminded me very much of the planet Mars, having much the same appearance." On May 21 and 29 he also saw dusky markings on the planet's surface, with his 5¼-inch refractor, power 181. Mr. John Birmingham reports, that although he has been carefully observing Venus at every opportunity, he has failed to detect "any definite markings besides the well-known peculiar forms exhibited by the cusps, which appear to be brighter than other parts of the planet." Mr. H. W. Hollis, of Keele, Staffordshire, examined Venus on July 17, at 6h. 30m., with his 6-in. O. G., power 150. "The rounding off of the southern cusp was evident at a glance, and the prolongation of the northern one more remarkable than I have ever before observed it; a dusky, ill-defined, and uncertain-shaped spot was visible. On the 18th, at 5h. 15m., I suspected the presence of this spot again, somewhat nearer to the terminator, but of this I cannot speak positively."

OBSERVATIONS TO AUGUST 31, 1871.

SOLAR PHENOMENA.

Mr. T. W. Backhouse, of Sunderland, reports that "a fine group of spots passed the sun's centre in the southern hemisphere on the 17th of last month. I made the following measurements, in miles, of its chief spot:—

Date.	h.	m.	Umbra. Length.	Penumbra. Length.	Penumbra. Width.
August 11	21	20	...	82,000	46,000
13	21	20	...	71,000	about 18,000
14	3	30	14,500	...	...
14	20	0	16,500	66,000	...
15	21	15	16,500	65,000	34,000
18	3	30	9,500	59,000	39,000
20	21	0	...	75,000	...
21	21	20	rather small	divided into 4	...

"The penumbra had a more ragged appearance than is often the case. If this group has returned to this side of the sun, it contains no important spots this month. Another very fine group passed N. of the sun's centre on the 19th of last month (August). It generally contained two or three large penumbra, of which I made several measurements, and on the 18th they were united at 3h. 30m., making a penumbra 78,500 miles long, and 41,000 wide at its widest part, and at 21h. 10m., 84,000 miles long. By the 25th all its spots were so reduced as to be quite small."

AUGUST METEORS.—The Rev. S. J. Johnson, of Upton Helions Rectory, Devon, writes :—"The following watch I kept with regard to the August meteors shows they were seen to considerable advantage this year :—

DATE.		DURATION OF WATCH.		NUMBER SEEN.
		h. m. h. m.		
August 9	...	10 15 to 10 40	...	1
9	...	11 13 to 11 52	...	7
10	...	9 44 to 10 34	...	11
10	...	11 4 to 12 12	...	42
11	...	10 36 to 11 36	...	20
12	...	10 56 to 11 28	...	5

"They were of a finer class than those of the last few years. Ten of those on the 9th were equal to 1st Mag. stars. Nearly all left momentary trains. On the 9th a very bright one burst into view a little below δ Cassiopeiæ, and shot towards η with a train of sparks. One on the 10th, near Cor. Caroli, was equal to Venus. I fancied the radiant point on the 9th was a trifle to the left of the cluster 33 ♅, but subsequent nights made me think it much lower down in Perseus." Mr. William F. Denning, of Bristol, observed the following number of meteors during a portion of three evenings of observation :—

DATE.		DURATION OF WATCH.		NUMBER SEEN.
		h. m. h. m.		
August 9	...	11 30 to 12 0	...	7
	...	12 0 to 13 0	...	27
	...	13 0 to 14 0	...	8
	...	14 0 to 15 0	...	21
10	...	10 0 to 11 0	...	17
	...	11 0 to 12 0	...	27
	...	12 0 to 12 30	...	27
11	...	10 35 to 10 50	...	18
	...	11 0 to 12 0	...	29
	...	12 0 to 12 15	...	16
	...	12 15 to 12 30	...	15
	...	12 30 to 13 0	...	23
	...	13 0 to 13 15	...	11
	...	13 15 to 13 30	...	14

"Most of the meteors observed, especially those on Aug. 9, were exceedingly small and scarcely discernible. Several brilliant ones were, however, observed. At 12h. 23m. on Aug. 10, a meteor of great lustre, and star-like in appearance, diverged from Perseus towards the horizon; it was of a blue colour, and left a trail of light marking its path, which was visible for a few seconds. At 10h. 44m. on Aug. 11 another brilliant one was observed. It passed equal to Venus, and was visible in Ursa Minor. The train which it left remained perceptible for a few seconds. It was, however, at about 12h. 50m. on the latter date that the most brilliant meteor was observed. It passed between the fourth Mag. stars ϵ and ζ in Cygnus, and soon afterwards disappeared, leaving in its flight a train which could be seen for about 7 seconds after the extinction of the meteor itself. This one, like the great majority of those observed, radiated from or near the small star B in Camelopardalus, situated at about R. A. 48° 37′ and N. D. 59° 18′. There were several small meteors observed in close proximity to this point; not many were seen to come from other directions. At 11h. 25m. on Aug. 10 a rather brilliant one passed from the bright star Scheal in Pegasus to Cassiopeia."

ENCKE'S COMET, OCTOBER, 1871.

1871.		R.A. h. m. s.		DECL. ° ′
Oct. 1	...	1 43 41	...	+33 37
3	...	1 39 6	...	34 12
5	...	1 33 55	...	34 48
7	...	1 28 4	...	35 23
9	...	1 21 28	...	36 59
11	...	1 14 3	...	36 33
13	...	1 5 43	...	37 7
15	...	0 56 25	...	37 39
17	...	0 46 4	...	38 8
19	...	0 34 34	...	38 34
21	...	0 21 52	...	38 54
23	...	0 7 56	...	39 8
25	...	23 52 45	...	39 14
27	...	23 36 19	...	39 10
29	...	23 18 44	...	38 54
31	...	23 0 7	...	38 24

A New Minor Planet, No. 114 of the Series, was discovered by Dr. C. H. F. Peters, at Hamilton College, Clinton, U.S., on July 23rd, 1871. It was also found independently on Aug. 6th, by J. C. Watson, at Ann Arbor, Michigan, U.S.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN OCTOBER, 1871.

BY W. R. BIRT, F.R.A.S.

Day.		Supplement ☾ — ☉ Midnight. ° ′		Objects to be observed.
16	...	143 10·9	...	Azout, Bernouilli, Struve.
17*	...	129 40·4	...	Biela, Boguslàwsky, Boussingault.
18	...	116 16·1	...	Guttemberg (*a*), Bohnenbeger the Pyrenees.
19	...	103 1·1	...	Arago, Mt. Argæus, Arnold.
20	...	89 56·9	...	Stöfler (*b*), Aristillus (*c*), Autolycus.
21	...	77 4·2	...	Archimedes (*d*), Cassini, Apianus.
22	...	64 23·0	...	Nasireddin, Huggins, Miller (*e*).
23	...	51 53·3	...	Beer and Mädler (*f*), Tobias Mayer.
24	...	39 35·4	.	Bessarion, Encke, the Mare Humorum (*g*).
25	...	27 29·7	...	Campanus, clefts in its neighbourhood.
26	...	15 36·8	...	Bayer, Billy, Hainzel.
27	...	3 57·0	...	Cardanus, Krafft, Olbers.
28	...	−7 29·5	...	Rock Mountains, Inghiransi.

For additional objects consult the lists for June and August.

* Moon near mean libration. The Epoch of mean libration is Oct. 4.

⁂ It is very important to register the extents of shadows near the terminator in part of the diameters of Craters, and in the case of mountains in diameters, their multiples and parts of the apparent diameters of their bases.

(*a*) A re-observation of the objects figured by Birmingham, near Guttemberg, is very desirable. See list for August.

(*b*) The same remark applies to Stöfler. The largest Crater on the S.W. of Stöfler has been named FARADAY.

(*c*) Should Aristillus be in sun-light, a ring on its Northern border may be looked for. It should be carefully drawn and its features described. It is evanescent and is soon lost sight of. If not in sun-light, on the 20th, look for it on the next evening.

(*d*) See *English Mechanic*, No. 334, Aug. 25th, 1871, p. 565, for a sketch by Gaudibert, of Archimedes, with the clefts in its neighbourhood.

(*e*) The Craters on the S.E. and N.W. of Nasireddin have been named HUGGINS and MILLER respectively, to commemorate the joint Spectroscopic labours of these physicists.

(*f*) A fine pair of small Craters between Archimedes and Timocharis.

(*g*) The Ridges and Craters on the surface form a fine study during the passage of the terminator.

Errata in former lists: July 29, for *Blancauus* read *Blancanus*; Aug. 24, for *Pietel* read *Pictet*; Sept. 18, for *Mesius* read *Metius*; Sept. 19, for *Cyrillius* read *Cyrillus*; Sept. 21, *dele* comma between Sulpicius and Gallus; Sept. 23, for *Bovpland* read *Bonpland*; Note (*f*), for *hue of light* read *line of light*.

Errata, page 207, par. 2, line 5, for *where* read *whence*. Page 208, line 24, for *shown* read *shews*. Line 9 from bottom, for *Satellite* read *Satellite I.* Line 21 from bottom, for *Phenomena* read *Phenomenon*.

SUN.

Greenwich, Noon. 1871.		Heliographical longitude of the apparent centre			Heliographical latitude of the sun's disc.		Angle of position of the sun's axis.
		°			°		°
Oct. 1	...	125·57	—92 δ ξ	...	+6·62 N	...	26·21
2	...	138·78		...	6·57	...	·27
3	..	151·99		...	6·52	...	·33
4	...	165·20		...	6·46	...	·37
5	...	178·41		...	6·41	...	·41
6	...	191·62		...	6·35	...	·45
7	...	204·83		...	6·29	...	·47
8	...	218·14	—85 δ ξ	...	+6·22	...	26·49
9	...	231·44		...	6·16	...	·50
10	...	244·55		...	6·09	...	·51
11	...	257·60		...	6·02	...	·50
12	...	270·86		...	5·95	...	·49
13	...	284·07		...	5·88	...	·47
14	...	297·28		...	5·80	...	·44
15	...	310·48	—78 δ ξ	...	+5·73	...	26·41
16	...	323·69		...	5·65	...	·37
17	...	336·89		...	5·57	...	·32
18	...	350·10		...	5·49	...	·26
19	...	3·30		...	5·40	...	·20
20	...	16·51		...	5·32	...	·13
21	...	29·71		...	5·23	...	26·05
22	...	42·91	—71 δ ξ	...	+5·15	...	25·96
23	...	56·12		...	5·06	...	25·86
24	...	69·32		...	4·96	...	25·76
25	...	82·52		...	4·87	...	25·65

26	95·73		4·78	25·53
27	108·93		4·68	25·40
28	122·13		4·59	25·27
—				
29	135·34	—64 δ ξ	+4·49	25·13
30	148·54		4·39	24·98
31	161·74	—62 δ ξ	4·28 N	24·82

MOON'S TERMINATOR.

Greenwich, Midnight	60°N.	0°	60° S.
		SUNSET.	
	°	°	°
1871. October 1	+58·1	+55·3	+52·9
2	45·9	43·3	40·7
3	33 7	31·1	28·6
4	21·5	19·0	16·4
5	+9·3	+6·8	+4·2
6	—2·9	—5·4	—8·0
7	15·1	17·6	20·1
—			
8	27·3	29·8	32·3
9	39·5	42 0	44·5
10	51·8	54·2	56·7
11	64·0	66·5	68·9
12	—76·2	—78·7	—81·1
		SUNRISE.	
16	+50·1	+52·5	+54·8
17	38·0	40·3	42·6
18	25·8	28·1	30·4
19	13 6	15·9	18·2
20	+1·5	+3·7	+5·9
21	—10·7	—8·5	—6·3
—			
22	22·8	20·7	18·5
23	35·0	32·8	30·6
24	47·1	45·0	42·8
25	59·2	57·1	55·0
26	71 4	69·3	67·2
27	—83·5	—81·4	—79·4
		SUNSET.	
28	+88·6	+86·4	+84·4
—			
29	76·4	74·3	72·3
30	64·1	62·1	60·2
31	+51·9	+50·0	+48·1

METEOR.—On the Evening of September 6th, at about 9h. 20m. a magnificent bolide, with a luminous train, which remained visible for 7 or 8 seconds, was observed at the Royal Observatory of Florence, near Arcetri. It traversed the constellation of the *Dragon*, and went towards the *Great Bear*. Before and after its appearance, there fell a light rain of very small meteors, which had the constellation of *Cassiopeia* for their radiant point.—*L'Italie*. Sept. 8th.

VARIABLE STARS.

1871.	G. M. T. h m.			mag.	Place of Star 1855. A. R. h. m. s.	Decl. ° ′
Oct. 2	6 1	U Coronæ	min.	9	15 12 17	+32 10·8
3		R Aquilæ	max.	6·7	18 19 23	+8 0·8
11		R Vulpeculæ	—	7·5	20 57 56	+23 14·9
12	15 1	Algol	min.			
13	17 6	λ Tauri	—			
14		S Leonis	max.	9	11 3 21	+6 14·9
15	11 9	Algol	min.			
16		S Sagittarii	max.	9·8	19 10 57	—19 17·1
17	15 1	S Cancri	min.	10	8 35 39	+19 33·2
—	16 5	λ Tauri	—			
18	8 7	Algol	—			
—		R Sagittæ	—	10	20 7 27	+16 17·4
—		S Vulpeculæ	—	9·5	19 42 27	+26 55·7
19		T Piscium	—	11	0 24 29	+13 48·0
20		R Cancri	max.	6·3	8 8 34	+12 10·1
—		R Pegasi	—	7	22 59 22	+9 45·7
21	15 4	λ Tauri	min.			
24		T Herculis	max.	7·5	18 3 37	+30 59·9
25	14 2	λ Tauri	min.			
26	10 1	U Coronæ	—	9	15 12 17	+32 10·8
—		S Ursæ maj	—	11	12 37 35	+61 53·3
27		T Pegasi	max.	9	22 1 49	+11 49·9
29	13 1	λ Tauri	min.			
30		S Arietis	max.	10	1 56 51	+11 49·7

COMET II. 1871.

M. Schulhof has calculated the following elements of the Orbit of this body:—

Perihelion Passage	=	July 26·97 B.M.T.
		° ′
Longitude of Perihelion	=	308 10
Longitude of Ascending Node	=	211 56
Inclination of Orbit	=	101 59
Longitude Perihelion distance	=	0·034819

The following ephemeris for the current month will be useful to many of our readers:—

1871.	R. A. h. m. s.	Decl. ° ′	Luminosity.
October 2	4 27 4	+55 43	1·87
4	4 10 39	54 12	
6	3 53 41	52 27	1·96
8	3 37 8	50 25	
10	3 21 6	48 8	2·0
12	3 5 51	45 36	
14	2 51 28	42 51	1·99
16	2 38 1	39 55	
18	2 25 33	36 51	1·90
20	2 14 5	33 43	
22	2 3 35	30 33	1·73
24	1 54 1	27 24	
26	1 45 19	24 19	1·52
28	1 37 28	21 20	
30	1 30 22	18 30	1·29

ASTRONOMICAL OCCURRENCES FOR OCTOBER, 1871.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Saturn
Sun	1		Sidereal Time at Mean Noon, 12h. 39m. 6·59s.			5 36·2
Mon	2		Sun's Meridian Passage, 11m. 11·20s. before Mean Noon			5 32·5
Tues	3					5 28·7
Wed	4	20 19	Conjunction of Venus and Mercury, 4° 41′ N.	3rd Sh. E. 2nd Sh. I. 3rd Tr. I. 1st Ec. D. 2nd Tr. I.	14 6 15 23 16 1 17 40 24 17 57	5 25·0
Thur	5			1st Sh. I. 1st Tr. I. 1st Sh. E.	14 50 16 5 17 9	5 21·2
Fri	6	5 31·6	☾ Moon's Last Quarter	1st Ec. D. 2nd Oc. R. 1st Oc. R.	12 8 42 15 22 15 41	5 17·5
Sat	7	9 27 16 14	Conjunction of Moon and Jupiter, 2° 36′ S. Conjunction of Moon and Uranus, 2° 29′ S.	1st Sh. E. 1st Tr. E. 4th Sh. I. 4th Sh. E.	11 37 12 54 13 59 17 20	5 13·7
Sun	8					5 10·0
Mon	9		Saturn's Ring: Major Axis=36·77″ Minor Axis=16·35″			5 6·3
Tues	10					5 2·6
Wed	11	15 53 16 50 15 0	Occultation of ν Virginis (4½) Reappearance of ditto Conjunction of Moon and Venus, 11° 54′ S.	3rd Sh. I. 2nd Sh I. 3rd Sh. E.	14 58 17 56 18 16	4 58·9
Thur	12		Conjunction of Moon and Mercury, 3° 17′ S.	1st Sh. I 1st Tr. I.	16 44 18 1	4 55·2
Fri	13	18 19·3	● New Moon	2nd Ec D. 1st Ec. D. 1st Oc. R. 2nd Oc. R.	12 31 23 14 1 50 17 36 18 1	4 51·5
Sat	14			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 12 12 30 13 31 14 49	4 47·8
Sun	15	23 25	Opposition of Neptune Illuminated portion of disc of Venus=0·108 " Mars=0·919	1st Oc. R. 2nd Tr. E. 3rd Oc. R.	12 4 12 45 13 37	4 44·1

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Mon	16		Sidereal Time at Mean Noon, 13h. 38m. 14·89s.	4th Oc. D. 4th Oc. R.	11 46 15 43	4 40·5
Tues	17	12 7	Conjunction of Moon and Mars, 2° 2′ S.			4 36·8
Wed	18	21 34	Conjunction of Moon and Saturn, 1° 31′ N.			Moon. — 3 47·1
Thur	19		Sun's Meridian Passage 14m. 54·08s. before Mean Noon			4 48·3
Fri	20	11 54·3	☽ Moon's First Quarter	2nd Ec. D. 1st Ec. D.	15 7 45 15 54 57	5 48·9
Sat	21			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 6 14 24 15 25 16 43	6 47·0
Sun	22			3rd Ec. R. 2nd Tr. I. 2nd Sh. E. 1st Oc. R. 3rd Oc. D. 2nd Tr. E. 3rd Oc. R.	12 12 28 12 25 12 39 13 58 14 10 15 19 17 37	7 41·6
Mon	23	8 40 9 14 9 50 11 0	Occultation of τ^1 Aquarii (6) Reappearance of ditto Occultation of τ^2 Aquarii (4) Reappearance of ditto	1st Tr. E.	11 12	8 32·6
Tues	24			4th Sh. E.	11 26	9 20·4
Wed	25					10 5·9
Thur	26					10 50·0
Fri	27	20 14·1 17 0 17 54	○ Full Moon Occultation of ξ^1 Ceti (4½) Reappearance of ditto	2nd Ec. D. 1st Ec. D.	17 44 7 17 48 4	11 33·7
Sat	28			1st Sh. I. 1st Tr I. 1st Sh. E. 1st Tr. E.	15 0 16 17 17 18 18 36	12 17·8
Sun	29		Saturn's Ring: Major Axis=35·69″ Minor Axis=15·79″	1st Ec. D. 2nd Sh. I. 3rd Ec. D. 2nd Tr. I. 2nd Sh. E. 1st Oc. R. 3rd Ec. R. 2nd Tr. E.	12 16 19 12 19 13 0 26 14 57 15 12 15 50 16 11 36 17 51	13 2·9
Mon	30	8 50	Near approach of B.A.C. 1361 (6)	1st Tr. I. 1st Sh. E. 1st Tr. E.	10 45 11 47 13 4	13 49·3
Tues	31	10 33 11 38	Occultation of *n* Tauri (6) Reappearance of ditto	1st Oc. R. 2nd Oc. R.	10 18 12 32	13 37·2

THE PLANETS FOR OCTOBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter.	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	11 28 38	+4 40	7″·2	22 45·8
	15th	12 43 34	—2 40	5″·3	23 5·5
Venus ...	1st	11 45 10	—6 51	58″·4	23 2·3
	15th	11 33 25	2 27½	51″·8	21 55·5
Jupiter ...	1st	7 55 10	+20 58½	34″·2	19 12·9
	15th	8 1 54	21 41½	34″·4	18 24·6
Saturn ...	1st	18 16 14	—22 50	14″·8	5 36·2
	15th	18 19 13	22 50½	14″·6	4 44·1
Neptune ...	4th	1 27 38	+7 18	3″·0	12 36·6
	16th	1 26 24	+7 10	3″·2	11 46·2

Mercury is excellently situated for observation in the morning, rising at the beginning of the month, nearly two hours before the sun, the interval decreasing to twenty-one minutes at the end of the month.

Venus rises at the beginning of the month, about half-an-hour before the sun, the interval increasing. Towards the middle of the month she will be worth observing.

Jupiter rises at the beginning of the month five hours and a half after sunset, the interval decreasing.

Saturn sets earlier each day, the interval varying from four hours to three hours and a quarter after sunset.

THE STABILITY OF THE UNIVERSE.

Should the rotation of the earth on its axis be increased by five seconds of time in twenty-four hours all the time-keepers in all the watch-towers of the world would proclaim the fact—all the stars would fail to keep their appointed meridian transits, and would, in sympathy with the great orbs of light, linger in their nocturnal march. The bursting out in the heavens of a thousand fiery comets in a single night could produce no such mortal terror to the astronomer, as this falling backward of the mighty sphere of the starry universe for one single second in twenty-four hours, for it would speak the doom of the universe, in announcing that God's right arm was growing heavy, and his omnipotent will was commencing to stagger under the weight of ten millions of rolling worlds. Should such an event ever occur—should the time ever come when indeed those shining sentinels in the high heavens should fail to keep their appointed vigils—when the astronomer shall look wistfully through the "optic tube" for the coming of the faithful star which, prompt to the thousandth of a single second, has traversed his meridian line, and, lo! the star lingers in its journey, seconds ebb slowly away and merge into minutes, and at last the star appears, no matter if with its wonted beauty, the astronomer stands aghast, and well may he tremble, for the powers of the heavens are smitten, and God is deserting the universe which sprang into being at his divine command. Human confidence and faith would be gone for ever, and no remedy could avail to rectify the wrong.

We have no fears that our confidence will ever be thus rudely shaken, not because we believe nature and her laws to be eternal, not because we believe that this stupendous mechanism endured from all eternity—for even then, after countless revolutions, a fault, an anomaly, a failure in the series of sequences might occur, and, with its terrific utterance, announce the possible running doom or destruction of the mechanism, but because I believe that God, the Eternal, All-wise, Incomprehensible, created and now sustains all things by the word of his power; it is because of God's eternity that we dwell in simple trust upon an unshaken order and a purpose to be achieved.—From *The Astronomy of the Bible.* By the late Professor and General O. M. Mitchel, U.S, formerly Director of the Cincinnati and Dudley Observatories.

The New Planet No. 114 has been named *Cassandra.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To September, 1871.

Elliott, R.

To December, 1871.

Gooch, Miss.
Guyon, G.
Holden, Rev. T. W.
Lawton, W.
Slater, J.
Weightman, Miss.

September 21, 1871. Subscriptions after this date in our next.

TO CORRESPONDENTS.

In answer to a Correspondent, we prefer to receive subscriptions in January and June.

We have received an interesting pamphlet, entitled "Notes on Eclipse Photography," by Mr. A. Brothers, describing minutely the photographic apparatus used at Syracuse; published for the benefit of those who wish to take part in the observation of the eclipse in December.

We are obliged to defer several interesting papers for want of space.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

The Astronomical Register is intended to appear at the commencement of each month; the Subscription (including Postage) is fixed at **Three Shillings** per Quarter, *payable in advance*, by postage stamps or otherwise.

The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 107. NOVEMBER. 1871.

NOTES ON THE WONDERS AND BEAUTIES OF THE STARRY HEAVENS.

BY C. GROVER, ASSISTANT TO JOHN BROWNING, ESQ., F.R.A.S.

No. 4. THE CONSTELLATION LYRÆ.

About 2½° north-east of Vega, we find a small star, which is perhaps better known and oftener observed than many of the greater lights of the firmament. This is Epsilon Lyræ, generally rated as of the 4th magnitude, but owing to its proximity to the brilliant α, it appears of considerably smaller magnitude. This simple effect of contrast is particularly apparent on some of our dark winter nights, especially if we compare our object with a few other stars, registered as of the same magnitude, but situated in parts of the heavens far removed from any brilliant neighbour.

Attentive examination shows something about this star quite sufficient to attract attention, in fact, the naked eye shows this star irregular, elongated or notched, and, in the case of some few persons, gifted with visual organs of exceptional power, even separated; this is, however, but rare, and the amateur, who can distinctly elongate this star without optical aid, has no reason to be disappointed; the smallest telescope, or even an opera glass, shows it as a widely separated and nearly equal pair of stars, known as ϵ^4 and ϵ^5, Lyrae, ϵ^4 being the most northerly star of the pair. A moderate increase of optical power suffices to exhibit each of these as a very interesting and neat pair, thus constituting what is familiarly known as the double-double or quadruple star in Lyræ, discovered by Herschel, in 1779.

The observer will at once remark the points of resemblance between these two pairs, the components of E^4 being 5 and 6½, and those of ϵ^5 5 and 5½ magnitudes respectively. There is also an absence of the strongly contrasted colours which characterize many of the compound stars, the tints of ε^4 are given as yellow and ruddy, and the components of E^5 are both white, in fact many a casual gazer would overlook the existence of colour altogether. The distances are given as 3″ 2 and 2″ 6 for ε^4 and ε^5 respectively. So that we have here the spectacle of two pairs of stars situated within 3½′ of each other, and with so many other points of resemblance as to strongly indicate the probability of some nearer connection than mere optical juxtaposition.

Micrometrical measurements have not only demonstrated the fact that such connection does exist, as evidenced by a continual change in the angular position of each pair; but, what is still more worthy of note, have shown that this motion is the same in direction in both cases, the motion being retrograde. From a discussion of the measures of various obververs, we find that in 75 years ε^5 (the most southern pair) has described an arc of about 28°, and in the same interval ε^4 has moved through about 16°, which a little calculation will show gives a period of 1000 and 2000 years respectively, supposing the movement to be continued uniformly, a condition of things, which in this case seems to be very likely of fulfilment, since in the period just referred to, the distances of both pairs have remained nearly unaltered. Clearly showing that their plane of motion must be nearly at right angles to the visual ray, and, therefore, that in this particular case, we observe the movements really as they are, without the complications unavoidably introduced when the inclination of the orbit to the visual ray, or excentricity of the orbit itself, required it to be allowed for. There appears to be but little doubt that both these pairs are linked together by some mysterious bond, and are slowly revolving around some grand centre, the position of which is at present unknown, and the period of whose vast cycle we are at present unable to comprehend.

These objects are rendered still more interesting from the presence in their immediate vicinity of several much smaller stars, much looked at by amateur observers, as tests of the light-grasping power of various telescopic apertures, one of these is very easily seen forming a triangle on the following side of the two doubles; preceding this, and situated on either side of a line joining the two pairs, are two much fainter stars, constituting the celebrated "Debilissima" couple, of Sir J. Herschel, and by him rated 13th magnitude. They are much brighter than this at present, and the late Rev. W. R. Dawes' estimation, giving them 10½ magnitude, is probably much nearer the mark, though few observers will be able to see them easily as Mr. Dawes did with a 3¾ achromatic, and they may be considered as about the limit of such an aperture. It is worthy of note that both these authorities class them as of equal brightness, but a very little attention will show a very perceptible difference; this has been noticed by the Rev. T. W. Webb, who, however, does not tell us which star takes the lead. I found the difference very noticeable in 1867 with a 6½ inch silvered glass reflector, and from not being able to always perceive them with equal distinctness, I have been inclined to suspect them of variation. The following extracts from my notebook are inserted as examples of the changes observed :—1867, May 19th. The two stars very unequal. N.F. the brighter by fully half a magnitude. June 10th. South Preceding star the brighter, when a stop is applied to the 6½ speculum which extinguishes the North Following star, the other is still visible. June 29th. N.F. star the brighter by ½ magnitude. August 23rd. S.P. star the brighter by ½ magnitude. Such changes as these, alternating with nights on which these two stars are so nearly equal that the difference is scarcely perceptible, are certainly very interesting, and I regret that I have not been able to devote more attention to their variations. I have looked at them occasionally since the above dates with the 12¼ speculum, and with the same results, sometimes one and sometimes the other being the brighter; and here there could be no possibility of deception, since the two stars are both visible in the same field of view, and, therefore, form an excellent check on each other. They are also equally liable to be affected by whatever atmospheric conditions prevail at the time of observation, added to which, they are such conspicuous objects with this aperture as to become visible in broad twilight. As soon as the sun is sufficiently below the horizon as to allow the naked eye to detect Vega, and long before ε itself can be discovered by the unaided sight, I have often seen these two little stars in the field of the telescope. Preceding the pair just mentioned, are three other small stars, forming a triangular figure; the star forming the southern angle being the smallest. Contrary to what is observed of many other celestial objects, these stars are best seen with a considerable magnifying power; an achromatic eye-piece, giving a power of about 450, shows them admirably.

We have still to add another star to this remarkable group. A minute point of about the 15th magnitude lies to the north of the North Following star of the Debilissima, and about one-third the distance between this and E^4. This star is just visible with a 6⅞ inch speculum, and may be taken as the smallest star to be distinctly seen with such an aperture.

This addition, bringing up the number of stars composing this group to eleven, concludes our present notice. Nevertheless, it is evident that, especially as regards two of this number; we have yet much to learn. Therefore, continued and careful observations are very desirable, and would probably lead to most interesting results.

REVIEW.

A Chart of the Northern Hemisphere on an equal surface projection, with a Key made by R. A. Proctor, B.A., F.R.A.S.

A. Brothers, Manchester.

Some idea of the amount of pains and labour bestowed upon this extraordinary map may be gathered from first paragraph of the explanation :—"In this chart there are 324,198 minute dots, and each of these dots represents a star. Each star has been copied in with careful attention, both to position and size, from Argelander's splendid series of star charts. The present chart is intended to bear the same relation to Argelander's series of charts, that the maps of the hemisphere in an ordinary atlas bear to the maps of the several countries. The forty charts of Argelander's series we have included in a single chart, on a scale very much reduced, of course, but in such a way as to show the laws according to which the stars, down to the 9-10th magnitude are distributed over the northern hemisphere."

The chart is especially intended to show where the stars are richly and where sparsely strewed on the celestial vault. Before the work of star charting commenced, the surface covered by the chart was divided into 26,400 spaces, answering to the corresponding spaces in Argelander's series of charts. Into these spaces the stars were carefully copied—the time occupied in the work being 400 hours.

To make a comparison with the work of others, the Herschels in their gauges counted but 160,000 stars, while Struve dealt only with 31,000. This chart includes 324,198 stars.

Mr. Proctor announces that he is about to publish a treatise upon the lessons to be learnt from the chart, which we shall be glad to see.

We cannot do better than conclude this notice with the author's concluding remarks :—" To the general student of science, the chart is chiefly of use in affording the means of enlarging his conceptions respecting the glories of the celestial depths. If he remembers that every one of the dots in the chart represents in reality a sun—a sun, perhaps, exceeding our own in magnitude and splendour, he cannot fail to be impressed with the grandeur of the stellar universe. More than a hundred times as many stars as he can see on the darkest and clearest night are here represented. While the student of astronomy remembers that if his powers of vision were so increased as to command the same range as Argelander's telescope (2¾-in. in apert), he would see each night as many as are shown in the photographic chart; let him further consider that a hundredth part of the celestial vault would exhibit, under the power of the Herschelian gauging telescopes, as many stars as are shown in the whole extent of the present chart. Even this enormous increase is but little, compared with that which would result could the powers of Lord Rosse's great mirror be applied, and *nothing* by comparison with the real number of luminaries which exist amid the depths of space."

It is not a little curious that some of the spots most barren of stars are the very borders af the milky way.

We were unable, through press of matter, to print the two following important letters last month, which will doubtless be wanted for future reference.—Ed.

FUTURE SOLAR ECLIPSES.

Sir,—The important physical observations which have been made during recent total eclipses of the sun have invested these phenomena with an interest independent of that attaching to the striking appearance in nature witnessed on these occasions, which have so frequently formed the subject of wonder and admiration in past times. I am thereby induced to send you a brief notice of the total eclipses which will occur during the next twenty years, founded upon a series of calculations undertaken for my own information. and very recently completed. I shall avoid introducing numerical results to any extent, and trust to verbal description as affording a sufficient guide to the course of the moon's shadow over the surface of the earth in each eclipse. I shall endeavour, also, to indicate the localities in which observations may be made with the greatest advantages. One or two eclipses, where the apparent diameters of sun and moon will be so nearly equal as to unfit them for favourable physical observation, will be omitted.

The eclipse of the 12th of December next is described generally in the various ephemerides. It will be total in Southern India and in Ceylon in the early morning. At Ootacamund, the sanitary station in the Neilgherry Hills, for 2m. 8s., totality commencing at 7h. 32m. 53s. a.m., local mean time, with the sun 18 degrees above the horizon. The first contact of limbs occurs here a quarter of an hour after sunrise, so that the whole eclipse is visible. At Trincomalee totality commences at 7h. 55m. 45s. a.m. local time. and continues 2m. 11s. In the northern part of the Australian continent the eclipse may extend over more than four minutes. Expeditions are organizing for several stations along the central line. In the Neilgherries, in particular, it appears favourable weather is confidently expected. I remark upon other eclipses in order of date :—

1. The eclipse of 1874, April 16.—The central line commences in the Antartic Regions, near the position marked upon our charts as "Weddell's farthest," and crosses Southern Africa, from the Orange River district to Natal. The only locality in which observations could be advantageously made lies between the Orange River and Lion mountains, near the west coast, in about 29 degrees south latitude. Taking as a point for special calculation 18 degrees E., 29 degrees, 11 minutes S., I find the last ray of sunlight disappears at 3h. 53m. 54s. p.m. local time, and totality continues 3m. 37s., the sun at an altitude of 22 degrees ; this point is very near the central eclipse. On the eastern coast the sun's elevation is less than ten degrees ; at Port Natal he is obscured for 50 seconds only, but some 75 miles further north the total eclipse may extend to nearly three minutes. At the Royal Observatory, Cape of Good Hope, there is a very large partial eclipse, the greatest phase at 3h. 50m. p.m.

2. The eclipse of 1875, April 6.—The greater part of the central line rests upon the Indian Ocean, from Madagascar, in a north-easterly direction, but it will traverse Further India (British Burmah) and Siam, and the totality may be very favourably observed in this region, the sun being high in the heavens. At Mergui he is obscured 4m. 6s., at Tenasserim 2m. 48s., and at Ban-kock 3m. 19s. At Mergui, which is near the centre of the shadow, the sun disappears at 1h. 59m. 40s. p.m., while at an altitude of 60 degrees.

3. The eclipse of 1876, September 17.—The total phase commences a little below the equator, north of New Guinea and passes over the Pacific to the south-west of Cape Horn ; it appears to escape all the principal islands ; in 175 degrees W. the duration is 1m. 40s., which is nearly the *maximum*. The phenomenon does not promise to be of utility to the physical astronomer.

4. The eclipse of 1878, July 29.—The belt of totality runs from the mountains north of Nertchinsk, in Siberia, over Behring's Straits, British Columbia, the Western States of America (Colorado, Texas, &c.,) and by Havannah to Port-au-Prince, Hayti, near which point it passes off the earth. In 135 degrees 30 minutes W., and 59 degrees 30 minutes N., where the sun will be near the meridian, the duration of total eclipse is 3m. 6s. ; at Denver, Colorado, 2m. 47s. ; at Havannah, 1m. 53s. ; and at Port-au-Prince, 1m. 24s. ; but here the sun is less than 5 degrees from the west horizon. This will be the fourth return of the great eclipse of 1806, which was also visible in the United States.

5. The eclipse of 1882, May 17.—The central line commences in the Ashantee territory, traverses Africa to Upper Egypt and the extremity of the Sinaite peninsula at the entrance of the Gulf of Akabah ; the duration of totality here is rather less than two minutes. The after course is by Teheran and Kashgar, across the Chinese Empire to Shanghai, where the eclipse is total for 20 seconds only, with the sun 18 degrees high.

6. The eclipse of 1883, May 6.—The central line commences in 156 degrees E., about 35 degrees S. of the equator, and passes below Norfolk Island, the Friendly Islands, and among the Marquesas, ending in about 87 degrees W. and 14 degrees S. Its course is, therefore, a very unfavourable one for observations, being a sea-track almost throughout. If any station is found, it may probably be between 150 degrees and 160 degrees west longitude. In the longitudes of the Marquesas, the sun may be observed 5m. 15s.

7. The eclipse of 1885, September 9.—Begins at sea, east of Tasmania,

and is total in New Zealand in the southern part of the Northern Island. At Wellington totality continues only 40 seconds, the sun disappearing at 7h. 42m. 22s. a.m., at an altitude of 15 degrees; but some 35 miles further north, it may extend over nearly two minutes. The south latitude of the central line afterwards increases until it passes off the earth within the Antarctic Circle. New Zealand will, consequently, be the only available station in this eclipse.

8. The eclipse of 1886, August 29.—As regards the length of duration of totality, this will be the most notable phenomenon within the period of which I am writing. The central line commences among the more southerly of the Bahama Islands, and, traversing the Atlantic, meets the coast of Africa, near Portendik, leaving this continent on the eastern side, south of the equator, and ending 2 degrees north of the upper extremity of Madagascar. Calculating for a point on the West Coast of Africa in latitude 17 degrees 55 minutes S., which is about ten miles south of Portendik, and close upon the central line, I find the total eclipse commences at 11h. 27m. 36s. a.m., local time, and continues 6m. 21s., the sun being at an altitude of 79 degrees.

9. The eclipse of 1887, August 19.—Frequent reference has been made in astronomical works to this eclipse, on the assumption that the line of totality would reach England. This, however, is now known to be an error. The central line begins at Bernberg in Anhalt, passes near Wilna and across Russia to Perm, thence by Tobolsk and rather north of Irkutsk to Manchooria, and over Japan in about 38 degrees N., to the Pacific, where it ends in 174 degrees E., and 24 degrees 30 minutes N. The duration of totality at Wilna, one of the most westerly points at which the sun can be well seen, is 2m. 15s., but on the shores of Lake Baikal, where he is nearly on the meridian, it may extend to 3m. 40s.

10. The eclipse of 1889, December 22.—Commences in the Carribbean Sea, and, passing over Barbadoes into the Atlantic, arrives on the African Coast in Angola, thence traversing Lake Tanganyika, it continues its course to the Indian Ocean, and leaves the earth in about 61 degrees E., and 7 degrees N. At Bridgetown, Barbadoes, totality begins at 6h. 47m. 6s. a.m., with the sun at an altitude of 6 degrees, and continues 1m. 48s. On the Angola coast in 10 degrees south latitude, he is 56 degrees above the horizon, and is obscured 3m. 34s., the middle of the eclipse falling at 2h. 11m. p.m. local time.

This completes the list of total eclipses which will be available for physical observations during the next twenty years. In one or two cases, however, it will be seen that such observations may be attended with great difficulties.

I am, Sir, your most obedient servant,

Mr. Bishop's Observatory, Twickenham: J. R. HIND.
Sept. 6. —*Times.*

THE APPROACHING TOTAL SOLAR ECLIPSE IN INDIA.

Sir,—It may interest your readers to know that owing to the prompt liberality of the Government in India, Colonel Tennant, R.E., F.R.S., has had placed in his hands sufficient funds for instruments, and for covering all the charges of an expedition to the South of India for observations of the total eclipse of the sun on the 11th of December. Through Lord Mayo's kind personal interference, Colonel Tennant, who had just been appointed to the charge of Her Majesty's Mint at Calcutta (in the absence of the Master), has received permission to superintend the expedition in person.

He will be assisted in observations with the spectroscope by Captain Herschel, R.E., F.R.S. The photography will be undertaken by Mr. Hennessey, of the Great Trigonometrical Survey. In addition to these gentlemen, Colonel Tennant has the promise from Major Montgomerie (acting for Colonel Walker) of two trained assistants. The observations will be made at the old meteorological station of Dodabetta, lat 11° 25′ 5″ N. long. 76° 43′82″ E., which is on one of the highest peaks of the Neilgherries, 8,650 feet above the sea.

Colonel Tennant will be well provided with instruments most suitable for a spectroscopic examination of the phenomena of the eclipse and for the delineation by photography of the outer portions of the corona. It may be mentioned that the Astronomer Royal, with the sanction of the Admiralty, has grànted the use of one of the 6-in. equatorials, constructed by Messrs. Simms for the observations of the transit of Venus.

The great skill which Colonel Tennant and Captain Herschel exhibited in their very successful observations of the total eclipse of 1868, and the experience in the observation of so exciting and temporary a phenomenon as a solar eclipse which they then gained, together with the perfect acquaintance of these gentlemen with the subsequent observations of the eclipse of 1869 in America, and that of last December in Europe, and, consequently, with the special observations which are now most needed for the increase of our knowledge of the nature and extent of the sun's surroundings, justify the most sanguine expectations as to the great value of the new information we shall gain from this expedition.

WILLIAM HUGGINS.

Upper Tulse-hill: August 19. —*Times.*

We hear from *Nature* that the arrangements of the Eclipse expedition are nearly all made, and that the numbers are now complete. The expedition sails on Thursday the 26th in the *Mirzapore*, arriving at Point de Galle on the 27th November, if all goes well. M. Janssen, we believe, is already *en voyage.* Professor Respighi, of Rome, will accompany the English expedition.

The Madras Government have sanctioned an advance of 2,000 rupees being part of the expenditure on account of their assistant astronomer who is to proceed to England, in order to undergo the necessary training in celestial photography. He is to return to Madras, fully primed, in December next, in time for the total eclipse of the sun, which is to take place on the 12th of that month, and will be prepared to take photographs of the different phases of the phenomenon. *Times of India.*

DEATH OF MR. BABBAGE.

The death is announced of Mr. Charles Babbage, who has long held high rank amongst the mathematicians of the day. He was, with Herschel, one of the founders of the Royal Astronomical Society. He was born on December 26th, 1792, and was educated by the Rev. Stephen Freeman, of Forty Hill, Enfield, Middlesex, from whom he imbibed his intense love of mathematics, one of his schoolfellows being the late Captain Marryat, the novelist. He proceeded to Trinity College, Cambridge, where he took his B.A. degree in 1814, but curiously enough his name does not appear in the mathematical tripos. In the course of his mathematical studies he found fault with the logarithmic tables then in use as being defective and unfaithful, and in order to improve them visited the various centres of machine labour in England and on the continent, and on his return directed the construction of a "difference engine," for the use of the government. Another result of this tour was the production of his work on the "Economy of Manufactures." By 1833 a portion of his machine (popularly known as "The Calculating Machine") was prepared, and its operations were entirely successful. It was, however, never completed. He next prepared his "Tables of Logarithms of the Natural Numbers from 1 to 108,000," a work which was so highly esteemed that it was very soon afterwards translated into almost all the European languages. In 1811 Mr. Babbage was elected Lucasian Professor of Mathematics, an office which had been filled by Sir Isaac Newton, Dr. Isaac Barrow, Bishop Turton, Professor Airey, and other eminent persons. This post he resigned in 1811. Amongst his most prominent works may be mentioned "A Ninth Bridgwater Treatise," the design of which was to show the error of a supposition implied in the first volume of that celebrated series, that ardent devotion to mathematical studies is unfavourable to religious faith. Mr. Babbage once, and it is believed once only, sought political honours, having become in 1832 a candidate for the borough of Finsbury, in the advanced Liberal interest, but was not successful. He was a Fellow of the Royal Society, and a member of a large number of literary institutions.—*Standard.*

THE SUN'S PARALLAX.

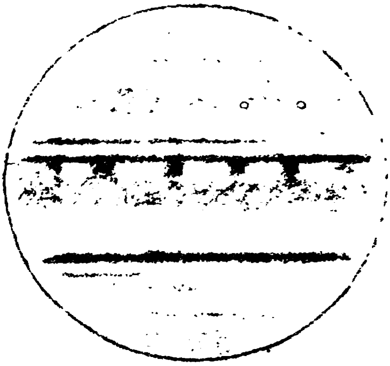
Is there nobody who will perform an act of justice and ask those, who seem to have never known or to have forgotten my doings, to be kind enough not to deprive me of my just claims? When, A.D. 1857, my old method of determining the sun's parallax was again publicly proposed, I thought it somewhat strange and wondered what could be the reason, that it should be treated as if it were some new and not a very old acquaintance of science. When, some time later, a stir was made about what was represented as a new method of investigating the motion of the solar system in space, and, instead of a new, there was brought forward an old acquaintance (known to science since the times of your grandfathers), only dressed anew and engaged to perform some truly "astounding" antics, I wondered indeed that no friendly hand should have prevented such an exhibition, but I also comprehended the true state of affairs. And, since then, I have had to shrug my ghostly shoulders so often, when learning further news about your curious knowledge of science, and your strange opinions, and your queer notions of honour and justice and fairness, that I have long ceased to wonder at anything some of you may say or do. However, as it is only right that I should be allowed to retain what belongs to me, and as nobody appears to remember my claims, you will probably raise no objection, if I myself enlighten you a little and remind you, how, A.D. 1672, I determined the sun's parallax.

Read in the history of my life [Bailey's Account, etc., p. 32]. "Whilst I was enquiring for the planets' appulses to the fixed stars by the help of Hecker's ephemerides, I found that, in September, 1672, the planet Mars, then newly past his perihelion and opposition to the sun, would pass amongst three contiguous fixed stars in the water of *Aquarius*: and that, by reason he was then very near the earth, this would be the most convenient opportunity, that would be afforded of many years, for determining his, and consequently the sun's horizontal parallax. I drew up a *monitum* of this appearance, and sent it with a letter to Mr. Oldenburg, who printed

OBSERVED AT MR E. CROSSLEY'S OBSERVATORY *PARK ROAD, HALIFAX.*

JUPITER

1



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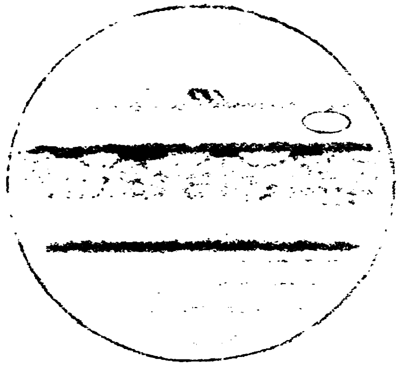

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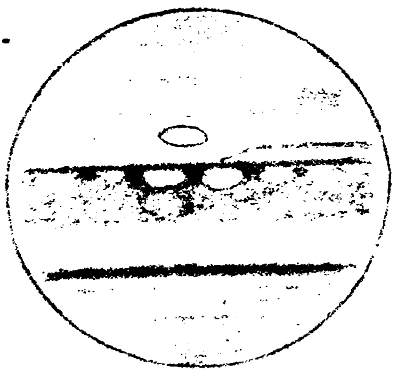

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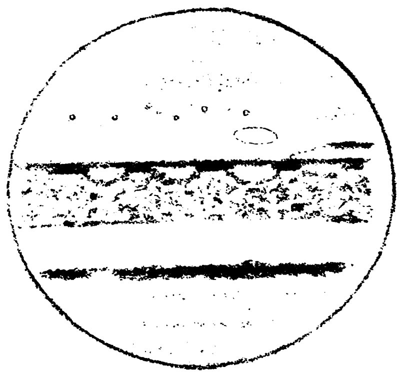

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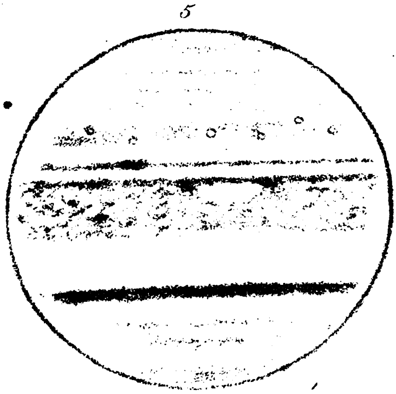

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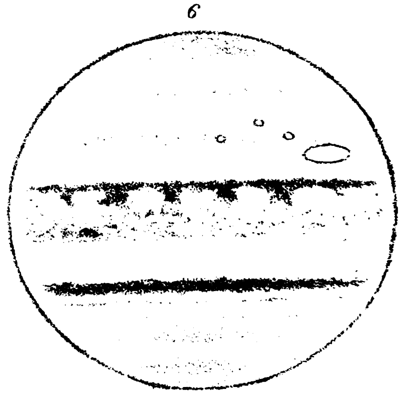

1 Jan 25th 1870. 7h 15m G.M.T
2 " 23rd " 7h " " "
3 Nov. 25th 1869 11h 15m " " "
4 " " " 10h 30m " " "
5 Dec 21st " 11h 10m " " "

it in his *Transactions*, No. 86, August 19th, 1672: having before sent my admonition into France, where the gentlemen of their Academy took care to have it observed in several places. My father's affairs caused me to take a journey into Lancashire, the very day I had designed to begin my observations; but God's Providence so ordered it that they gave me an opportunity to visit Townley, where I was kindly received and entertained by Mr. Townley, with whose instruments I saw Mars near the middlemost of the three adjacent fixed stars. My stay in Lancashire was short: at my return from thence, I took his distances from two of them at different times of the night. Whence I determined his parallax, then 25″, equal to his visible diameter; which, therefore, must be its constant measure; and, consequently, the sun's horizontal parallax not more than 10″. This I gave notice of in the *Transactions*, No. 96; and the French, soon after, declared that from their observations they had found the same. Whether they will give such exactness, I leave to those who are skilful in these things to determine."

This extract is, I hope, sufficient, and I will leave it to you to search further. Perhaps you may consider my language a little quaint; but then, remember, I lived two centuries ago.

Now, the planet Mars performs 109 sidereal revolutions in 205 sid. years and 3¼ days, so that its appearance in the year 1877 will not be much different from what it was in 1672. Accordingly, I enjoin you to make then the most of your opportunity, and do your best to prove the goodness of my old method, and I wish you thorough success. And, when you watch the planet pass amongst the stars in the water of Aquarius, you will, perhaps, remember with kindly feelings an old astronomer, who in life had to endure great injustice and sore trials, and will bless and honour his memory.

Walhalla. THE GHOST OF JOHN FLAMSTEAD, M.R.

CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER IN OCTOBER, 1871.

Sir,—A few notes on some objects now visible on the disc of this planet will probably be read with interest by some of your readers. The lithographs will aid in the identification of the regions described.

October 9th, 1871. About 4 a.m., the air being very still and the sky quite free from cloud, a tolerable sketch was obtained. The equatorial bands and the region between appeared to be much the same as last year. No. 5 was well seen, and also two similar faint belts to the S. of it. No. 2 was the finest band on the disc, as has been the case for some years. No. 1 was also well seen: on it were two dark oblong spots, one being in the centre, and the other a little to the E. Above (to S.) the central spot, and in contact with the under edge of No. 2, was also a dark spot. But the most noteworthy object was a large spot lying in the bright zone between bands 2 and 3, and touching both of them. It was not very dark, nor yet well defined. It was seen again on the 11th October, about 4.30 a.m., but no better view was then obtained.

The festoons under No. 4 are again to be seen.

Mr. Edward Crossley's Observatory, Park Road, Halifax.

I am, Sir, truly yours,
JOSEPH GLEDHILL, F.G.S.

JUPITER.

Sir,—On February 20th of the present year, at 7.30 p.m., I turned my telescope on Jupiter, and was surprised to find the belts presenting quite an unusual appearance. All the equatorial belts were broken up into distinct masses of clouds, there being about four irregular parallel rows, each containing about five distinct and separate cloud-masses. Higher powers brought out this unusual scene most magnificently. A statement of this observation appeared in the Report of the O.A.S. to May 31st, 1871, and since then I have been anxiously waiting for it to be corroborated by other observers.

No other notice of the appearance of the planet on the above occasion has, however, appeared, and thus an important and almost unique phenomenon is unrecorded by a second observer. As it is impossible to imagine Jupiter not to have been scrutinized by others on the above date, I send this in hopes that some of your courteous correspondents may corroborate this interesting appearance, and possibly amplify it by the aid of larger instruments.

Yours faithfully,
ALBERT P. HOLDEN.

Hoxton Street, N.
Sept. 19th, 1871.

ARE HIGH POWERS THE BEST FOR VIEWING FAINT STARS?—MOONLIGHT NIGHTS.

Sir,—I have lately read some letters in a weekly paper (partly devoted of Astronomy), as to whether high or low powers, on moderate apertures to, say three or four inches, are the best suited for viewing faint stars; and as some difference of opinion seems to exist on this subject, I should be glad if this matter were a little "ventilated" in your able *Register*.

As far as my experience goes for viewing stars of the 11th and 12th magnitudes, I am decidedly in favour of using powers under or near 100 in preference to those above that figure.

My own refractor of 4¼-inches shows the "Comes" to *A. Lyræ* very easily with an eye-piece of about 70 times, but becomes a difficult object if magnified much over 100 times; and this applies in some degree to the companion to *Polaris*, which, by-the-by, I always think can be seen quite as readily in the brightest moonlight as when our Luminary is absent. I have often doubted whether it is correct to fancy that *the moon must be absent* to enable an observer to see such and such stars; my own impression is that many moonlight nights are wonderfully clear and transparent. Will some obliging correspondent kindly instruct one who prefers light to darkness?

I remain, yours faithfully,
WM. L. LANCASTER.

St. Aubin's Lodge, Hackney Downs:
21st October, 1871.

THEORIES.

Sir,—The common saying, "a miss is as good as a mile," received a happy illustration on the 26th July, when Mr. J. B. Smith's motion in the House of Commons, for abolishing all our existing weights and measures, and compelling the universal employment of the French or metric system, was negatived by the narrow majority of five. An excellent leading article on the subject in the *Times*, of the 27th of July, (in which the Parliamentary discussion also appeared,) deserves to be re-printed and widely circulated. Attention may also well be called to the late lamented Sir John Herschel's paper, entitled "The yard, the pendulum, and the metre," in his *Familiar Lectures on Scientific Subjects.*" Had the metric advocate succeeded, the wide-spread confusion, annoyance, and loss, described by the *Times*, would, in all likelihood, have speedily compelled the reversal of a measure, that has been proved to be untenable in a scientific, unsound in an economic, and undesirable in a social point of view. *Pace* its advocates,—some of whom are men of mark,—bad luck to their crotchet, if ever it shall be again brought forward! The fifth Report of the Standards Commission, of which our Astronomer Royal is a member, was given in the *Times* of July 28th.

Passing to another subject, Sir William Thomson, in his interesting inaugural address, at the recent meeting of the British Association, in Edinburgh, said: "We must regard it as probable in the highest degree, that there are countless seed-bearing meteoric stones moving about through space. If at the present moment, no life existed upon this earth, one such stone falling upon it might, by what we blindly call natural causes, lead to its becoming covered with vegetation. The hypothesis that life originated on this earth, through moss-grown fragments from the ruins of another world, may seem wild and visionary; all I maintain is that it is not unscientific." And, just before, the President observed: "Should the time when this earth comes into collision with another body, comparable in dimensions to itself, be, when it is still clothed as at present with vegetation, many great and small fragments carrying seed, and living plants and animals, would undoubtedly be scattered through space." A sensible and amusing article on this subject appeared in the *Times* of August 7th. It is a supposition which decidedly improves upon Monsieur Trissotin's notions, two centuries ago:

> " Je viens vous annonces une grande nouvelle,
> Nous l'avons en dormant, madame, échappé belle.
> Un monde près de nous a passé tout du long,
> Est chû tout au-travers de notre tourbillon ;
> Et, s'il eût en chemin rencontré notre terre,
> Elle eût été brisée en morceaux comme verre."*

An hypothesis, however, from a man of Sir William's eminence, cannot but be deserving of attention, formidable as may seem the difficulties in its way. For instance, as to the "moss-grown fragment," would not the heat produced by its passage and impact be likely to destroy vegetation? And, in the case of a fragment of some considerable size, carrying not only seed, but living plants and animals, the chances against its safe arrival appear to be immensely multiplied. Before a body at all comparable in dimensions to the earth could come in collision with it, there would be a tidal action, productive of disastrous effects: and, if the collision itself were such as to shatter our globe, and not merely produce an amalgamation, who can predict the series of terrible results? The heat generated by the impact,—the liberation of internal heat by the fracture, —the escape of molten matter and deadly gases,—electric phenomena on an unknown scale. And, supposing, nevertheless, that a fragment got off

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* Moliere. *Les Femmes Savantes.* Acte iv. Sc. III.

from such a "crash of worlds," carrying some animal and vegetable life on it, what would be likely to become of that life, in its passage to another world? The inclination of the axis of the fragment, and its rotatory velocity, probably differing considerably from the earth's, the seasons, days and nights, would be suddenly altered; the portion of atmosphere it took with it, dilating by reason of the small gravity, would bring about a serious change in density and temperature; to say nothing of the inconvenience of the immense and sudden increase in the muscular power of animals, proceeding from the same cause.

But, supposing some animal and vegetable life to survive these and probably other dangers besides, there would finally have to be encountered those attending on the arrival of the fragment at some other globe: a shock which, under the most favourable circumstances, could not be trifling. And, moreover, the air, water, and meteorological conditions of this other globe must needs not be very different from our own, in order that, after all, its newly imported fauna and flora might not perish almost as soon as it arrived. If it be difficult, and often impossible, to acclimatize plants and animals in foreign regions, in this world, what must we think, apart from dynamic considerations, of the difficulties attendant on their transport through vast regions of space to some other? The president said: "I am fully conscious of the many scientific objections which may be urged against this hypothesis, but I believe them to be all answerable." We must, therefore, be content to wait a little for elucidations, for which his long and valuable discourse could not afford space.

In regard to the mighty mystery of life itself, it is pleasant to read Sir William's remarks; especially to those who have not ceased to value and revere, as doubtless he does himself, a still more "excellent old book" than *Paley's Natural Theology*, to which he made reference. Of that transcendent mystery, indeed, we know, and are as likely to know, as little as ever. Its origin is as much veiled to our modern science, as it was to Epicharmus, in the beautiful mythic fable, by Alex. Von Humboldt, called "The Vital Force, or the Rhodian Genius." Sir William Thomson, well termed the belief "that life proceeds from life, and from nothing but life," an "article of scientific faith, true through all space, and through all time."

I am, Sir, yours, &c.
GEORGE J. WALKER.

BERTHON'S NEW DYNAMOMETER.

Sir,—Such of your readers as have hitherto trusted to the estimation given them, by the makers, of the power of their eye-pieces, will, no doubt, be very pleased to hear that they can now, at a very trifling expense, prove for themselves whether these estimations are accurate or not. Even the best telescope makers occasionally indulge in over-statements of this nature. The Rev. E. L. Berthon, F.R.A.S., well known as the inventor of many scientific instruments, has at length produced a Dynamometer, which, for accuracy, vies with the older sorts, and for cheapness leaves them far behind. I have tested it with ten eye-pieces, and found the results in each case very accurate indeed. The instrument consists essentially of a brass scale, by which is read the exact diameter of the luminous image of the object glass, or large speculum. The instrument reads to ·001 of an inch; as it is divided by machine, it may be fully relied upon for accuracy.

The maker, Mr. Tuck, of Romsey, will, doubtless, be happy to give every information to intending purchasers.

Yours faithfully.

F. W. LEVANDER, F.R.A.S.

Barnsbury: September 13, 1871.

CLEAR NIGHTS.

Sir,—When I commenced keeping a meteorological register, in 1849, it appeared to me that a record of the clear nights might be of some interest to myself and others, as indicating the astronomical value of the climate of Hull; and, although I made this a somewhat prominent point in a paper on the meteorology of Hull, read before Section A of the British Association, at its meeting in this town, in 1853, I was not aware, until I saw the communication of Mr. Johnson in this month's *Register*, that any other observer had included a clear night column in his register, an omission that always caused me some surprise and regret; inasmuch as it seemed to me, that such a record would be of service in pointing out the best site for any large telescope, similar to that of Mr. Newall's; and, I may further remark that if such records were also kept at all observatories, magnetical as well as astronomical, we should then probably possess a tolerably reliable register of the most favourable astronomical sites in the civilised world; and, here permit me to point out, that such a register as I am advocating already actually exists from necessity in the journals of all astronomical observatories, and only requires extracting. For instance, all those nights in which the memoirs of the observatory showed general observations had been made, would be clear nights at that time and place.

My interpretation of a clear night is the same as Mr. Johnson's; that is, clear up to or for some hours before midnight; but, it must not be understood that all the nights in the accompanying table were really good telescopic nights (many of them were found to be so from the writer's experience); they represent nights cloudless, or nearly so, to the hours above named, and which would be more or less available for telescopic uses, according to the amount and direction of the wind, moisture in the atmosphere, &c.

If you can allow the space, I shall be glad to see further contributions (tabular results) on this subject, particularly from West Yorkshire or some of the Midland Counties—say Nottingham, which latter county I am inclined to think will be found to possess a more favourable astronomical climate than either Devonshire or East York. They will at least be free from a phenomenon peculiar, I believe, to the east coast, known as the sea fog or sea reek, but which seldom in this locality extends over 20 miles inland. It chiefly prevails during the nights of the summer months, when a very hot and calm day is succeeded by an easterly wind, at or about sunset.

Yours truly,

WILLIAM LAWTON.

Hull: August, 1871.

CLEAR NIGHTS.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1849		6	7	8	8	15	14	3	6	12	13	9	101
1850	3	16	14	14	11	10	10	18	13	15	15	8	147
1851	11	14	12	12	12	16	4	13	12	10	15	7	138
1852	13	12	9	19	10	6	15	10	18	12	8	8	140
1853	14	5	15	5	14	11	7	7	9	5	13	7	118
1854	8	9	12	16	9	5	6	9	8	14	12	5	113
1855	4	4	6	11	9	8	6	6	9	7	3	7	80
1856	11	3	8	8	3	10	10	7	6	2	9	9	86
1857	7	6	7	5	7	11	12	6	10	6	6	9	92
1858	13	15	10	14	2	11	9	9	3	4	8	11	109
1859	8			8	16	4	5	10	8	9	7	7	82
1860	6	7	6	8	6	1	3	4	6	9	3	3	62
1861	4	7	13	8	9	5	7	10	10	7	9	9	98
1862	6	4	5	8	9	5	4	9	10	8	10	6	84
1863	8	9	9	9	8	13	12	1	6	11	13	13	112
1864	6	11	12	12	7	9	10	16	16	7	6	6	118
1865	10	4	8	14	13	10	3	7	20	15	7	8	119
1866	10	10	5	12	14	9	10	4	12	7	11	8	112
1867	4	7	5	7	5	10	5	12	7	7	5	11	85
1868	4	6	9	9	18	18	9	14	8	13	2	6	116
1869	3	4	3	11	3	8	8	10	10	8	9	5	82
1870	13	0	7	11	10	8	0	4	6	10	12	5	86
	$7\frac{19}{21}$	$7\frac{12}{21}$	$8\frac{14}{21}$	$10\frac{9}{22}$	$9\frac{5}{22}$	$9\frac{5}{22}$	$7\frac{16}{22}$	8·13	$9\frac{15}{22}$	9	$8\frac{20}{22}$	$7\cdot\frac{13}{22}$	

VARIABLE STAR.

Sir,—My observations during the present year fully confirm a suspicion I entertained that Mr. Birmingham's fine red star in Cygnus, zone + 47°, No. 3,077 of the Bonner Sternverzeichniss, would prove to be variable. Projecting the observations on cross-ruled paper, I find that the star passed a *maximum* 8·05 mag. on June 16th, a result which may, however, be a few days in error. Further observations will be required to fix with precision the elements of the light-curve; but the period would appear to be about one year, with a range of not less than 1·3 mag.

The variable, which will I presume be U. Cygni, may be easily found 9′·4 *n.* 4m. 10s. *f.* the 5th mag. star 32 Cygni. Its colour is fine, and it has a bluish 8·3 mag. neighbour, which forms a useful star of comparison.

I am, Sir, yours faithfully,

GEORGE KNOTT.

Woodcroft Observatory,
Cuckfield, Sussex: Sept. 16th, 1871.

SIR J. SOUTH'S 8-INCH OBJECT-GLASS.

Sir,—Can any of your readers, who were acquainted with the late Sir James South, inform me who was the maker of the 8-inch object glass of the 12-feet telescope, which was mounted upon a huge wooden framework, in the grounds of Sir James's house, at Kensington? This instrument has come into my possession, and is a fine specimen of an early achromatic. I have been informed that, at the sale of Sir James South's instruments, this object-glass was attributed to Dollond, but is it not more likely to have been the work of the elder Tulley?

Estate Offices, Keele, Near Newcastle, Staffordshire: August 24, 1871.

I am, Sir, your obedient servant,
H. W. HOLLIS, F.R.A.S.

DESIDERATA.

Sir,—The difference in the performance of the clocks or timepieces recommended by your correspondent, "Habens," and such as I described in my letter to the *Register* of September last, is so palpable to persons who have any experience in the matter, that I cannot understand how any one can attempt to make a comparison, except it be through ignorance.

"Habens," in his letter in the August No., says—"*The above is a first-rate timekeeper*;" and again in his letter in this month's *Register*, speaking of certain library and drawing room clocks actuated by a spring, they are said to be of "*unimpeachable veracity*." These terms certainly convey the idea of comparability to anything produced.

In conclusion, let "Habens" place his new sidereal clock beside a good *old* clock of even moderate pretensions with a 40-in. pendulum, driven by a weight and having a maintaining power and a "little month," if the experiment is fairly tried, will show the absurdity.

I am, Sir, yours, &c.,
JOHN G. ALLISON.

Whitburn, near Sunderland: October 16th, 1871.

NEPTUNE.

Sir,—Will you permit me to return my sincere thanks to your correspondent, Mr. S. J. Walker, of Teignmouth, Devon, for his great kindness in forwarding to me a chart of the small stars surrounding Neptune, and also copies of his very valuable and interesting pamphlets on the Arabic names of the stars, &c. I saw Mr. Walker's letter in the last number of the *Astronomical Review*, in which he said that he would furnish a diagram showing the position of Neptune to those desirous of obtaining it. I wrote, asking him for one, and he sent me the kindly response I have mentioned.

As I am endeavouring to instruct my pupils in the sublime Science of Astronomy, I feel particularly grateful to Mr. Walker, and I wish to thank him publicly through your columns.

Faithfully yours,
CHARLES W BENSON, LL.D.

Rathmines School, Dublin: 16th October, 1871.

Δ CYGNI.

Sir,—I beg to hand you the following recent measures of δ Cygni, made with my 7¼-inch Alvan Clark refractor, and a wire micrometer.

Aug. 10. $P=338^\circ{\cdot}72$ $D=1''{\cdot}875$
Oct. 12. $P=338^\circ{\cdot}06$ $D=1''{\cdot}633$
Oct. 13. $P=337^\circ{\cdot}72$ $D=1''{\cdot}637$

The distance at the first epoch is certainly too large. In my "Remarks" on that occasion, I have noted that the small star was only seen at intervals, and that the measures were very uncertain.

I am, Sir, yours faithfully,
Woodcroft Observatory, Cuckfield, Sussex: GEORGE KNOTT.
October 16th, 1871.

A METEOR.

Sir,—A meteor, the most brilliant I have ever witnessed, passed over Southampton last evening, precisely at nine o'clock, Greenwich time. It commenced in the tail of the Serpent, and travelled slowly downwards and to the westward, describing in its course a gentle curve, and passing through Ophiucus, finally disappeared below the horizon. In size it was apparently about four or five times as large as Jupiter. The colour was a beautiful violet tint, and reminded one of the effect produced when the metal potassium is burnt on the surface of water. It left a train of light behind which, notwithstanding the brilliancy of the moon, was clearly visible for several seconds afterwards. Possibly the same meteor might have been seen in different parts of England by other observers; if so, it would be interesting to compare notes, with the view of ascertaining the probable height.

I am, Sir, yours obediently,
Southampton: Oct. 2. W. B. S.
—*Standard.*

A BRILLIANT METEOR.

Sir,—I had the pleasure of witnessing a very brilliant meteor last evening, at about four minutes after nine. I was walking southward at the time, but its brilliancy caused me to turn round. It was then proceeding from the region of the Polar Star, passing close to δ and γ, and disappearing near χ in Ursa Major. It must have lasted several seconds, and changed in tint from pale blue to pink.

I am, Sir, yours obediently,
Earlswood, Red-hill, Surrey: WILLIAM WOOD.
Oct. 13. —*Times.*

A SUN-SPOT.

Sir,—A very remarkable spot is at present visible on the sun's disc. At nine this morning it measured 4 min. 20 secs. in length, or upwards of 114,000 miles. The penumbra, which was very narrow, contained three large umbræ and a great number of small spots.

I may add that the spot was easily seen at noon to-day with a small opera glass magnifying about three diameters.

I am, Sir, your obedient servant,
Bedford: October 12. THOMAS G. E. ELGER, F.R.A.S.

ENCKE'S COMET

SIR,—With the assistance of Mr. Hind's ephemeris I was able to find Encke's Comet the first time I searched for it, last night, readily enough. The sky was hazy and luminous, and the light of the moon at her first quarter was unfavourable for seeing so delicate an object well. I found the comet to consist of a diffused nebulosity of extreme faintness, apparently circular; the diameter was by estimation as much as six to seven minutes of arc; illumination of the micrometer webs was out of the question, even with my large aperture of 18 inches. After long gazing I became convinced that the condensation, which was evident enough, was not central, but chiefly on the following side.

The approximate position of the comet at 9h. 4m. Greenwich meantime was:—right ascension, 22 min. 30 sec.; declination, north 38 deg. 34 min.

I am, Sir, yours faithfully,
HENRY COOPER KEY.

Stretton Rectory, Hereford: —*Standard.*
Oct. 21.

Mr Hind states that he believes that he re-discovered Encke's Comet on September 22nd. It was somewhat out of its predicted place.

A New Minor Planet, No. 117 was discovered on September 8th, 1871, by Dr. C. H. F. Peters, at Hamilton College, Clinton, U.S.

VARIABLE STARS.

1871.	G. M. T.* h	m.			mag.		Place of Star 1855. A. R. h. m. s.	Decl. ° '
Nov. 1			R Camelopardali	max.	7·2	...	14 28 54	+84 29·2
—	16	7	Algol ...	min.				
2	12	0	λ Tauri ...	—				
—			S Hydrae ...	max.	7·5	...	8 46 0	+3 36·8
4	13	6	Algol ...	min.				
5	14	3	S Cancri ...	—	10	...	8 35 39	+19 33·2
6	10	8	λ Tauri ...	—				
—			R Bootis ...	max.	6·8	...	14 30 48	+27 22·1
7	10	4	Algol ...	min.				
10	7	2	Algol ...	—				
—	9	7	λ Tauri ...	—				
14	8	6	λ Tauri ...	—				
—			S Delphini ...	—	11	...	20 36 24	+16 34·2
15			S Vulpeculæ ...	max.	8·7	...	19 42 27	+26 55·7
18	7	4	λ Tauri ...	min.				
21	18	5	Algol	—				
24	13	5	S Cancri	—				
—	15	3	Algol	—				
25			T Aquarii ...	max.	7	...	20 42 17	−5 40·9
27	12	1	Algol ...	min.				
28			R. Orionis ...	max.	9	...	4 51 8	+7 54·4
29			R. Crateris ...	—	?	...	10 53 26	−17 32·8
30	8	9	Algol ...	min.				

* Hour and fraction of hour.

SUN.

Greenwich, Noon. 1871.	Heliographical longitude of the apparent centre		Heliographical latitude of the sun's disc.	Angle of position of the sun's axis.
	°		°	°
Nov. 1	174·94	—61 δ ξ	4·18 N	24·65
2	188·14		4·08	·47
3	201·34		3·97	·29
4	214·54		3·87	·10
5	227·74	—57 δ ξ	3·76	23·90
6	240·94		3·65	·70
7	254·14		3·54	·48
8	267·34		3·43	·26
9	280·54		3·31	·03
10	293·74		3·20	22·79
11	306·94		3·09	·55
12	320·14	—50 δ ξ	2·97	·30
13	333·34		2·85	·04
14	346·53		2·74	21·77
15	359·73		2·62	·49
16	12·93		2·50	·21
17	26·13		2·38	20·92
18	39·32		2·26	·62
19	52·52	—43 δ ξ	2·14	·31
20	65·72		2·02	·00
21	78·91		1·89	19·68
22	92·11		1·77	·35
23	105·30		1·64	·02
24	118·50		1·52	18·68
25	131·70		1·40	·33
26	144·89	—36 δ ξ	1·27	17·97
27	158·09		1·14	·61
28	171·28		1·02	·24
29	184·48		0·89	16·87
30	197·67		0·76	·49
Dec. 1	210·86	—31 δ ξ	0·64 N	·10

MOON'S TERMINATOR.

Greenwich, Midnight		60°N.	0°	60° S.
			SUNSET.	
		°	°	°
1871. Nov.	1	+39·7	+37·8	+35·9
	2	27·5	25·7	23·8
	3	15·3	13·5	+11·7
	4	+3·1	+1·3	—0·4
	5	—9·1	—10·8	12·6
	6	21·3	23·0	24·7
	7	33·6	35·2	36·8
	8	45·8	47·4	49·0

9	... 58·0	... 59·6	... 61·2	
10	... 70·3	... 71·8	... 73·3	
11	... —82·5	... —84·0	... —85·5	
—				
		SUNRISE.		
15	... +45·9	... +47·2	... +48·5	
16	... 33·7	... 35·0	... 36·3	
17	... 21·6	... 22·8	... 24·1	
18	... +9·5	... +10·7	... +11·9	
—				
19	... —2·7	... —1·5	... — 0·3	
20	... 14·8	... 13·7	... 12·5	
21	... 26·9	... 25·8	... 24·7	
22	... 39·0	... 38·0	... 36·9	
23	... 51·1	... 50·1	... 49·1	
24	... 63·2	... 62·2	... 61·3	
25	... —75·3	... —74·4	... —73·5	
		SUNSET.		
27	... +82·1	... +81·4	... +80·6	
28	... 70·0	... 69·2	... 68·5	
29	... 57·8	... 57·1	... 56·4	
30	... 45·6	... 44·9	... 44·3	
Dec. 1	... +33·4	... +32·8	... +32·2	

THE PLANETS FOR NOVEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	2nd	14 29 18	—14 27	4″·6	23 46·3
	15th	15 21 20	21 19½	4″·8	0 14·8
Venus ...	1st	11 55 8	—0 56½	39″·0	21 10·3
	15th	12 33 3	2 46½	31″·8	21 53·1
Jupiter ...	1st	8 7 7	+20 29	37″·3	17 22·9
	15th	8 8 38	20 27	39″·1	16 29·4
Neptune ...	1st	1 24 45	+7 1		10 41·7
	13th	1 23 37	6 55		9 53·3

Mercury is an evening star, but for a very short time—the interval between its setting and the sun's varying from one minute at the beginning to thirty minutes at the end of the month.

Venus is at her greatest brilliancy on the 1st of the month. She rises about three hours and a half before the sun, the interval increasing each day to the end of the month, when she rises four hours and a half before sunrise.

Jupiter is getting well situated for observation. He rises about four hours and three quarters after sunset, at the beginning of the month the interval decreasing.

Erratum in No 106, p. 247, line 15, for *doom* read *down*,

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. B. Ceti.
Wed	1	 23 10 7 30 8 24	Venus at greatest brilliancy Sidereal Time at Mean Noon, 14h. 41m. 19·76s. Superior conjunction of Mercury Occultation of 1 Geminorum (5) Reappearance of ditto	4th Ec. D.	17 38 12	9 54·2
Thur	2	10 54 16 11 17 19	Near approach of ω Geminorum (6) Occultation of 48 Geminorum (6) Reappearance of ditto	4th Oc. R. 3rd Tr. E.	9 36 11 26	9 50·3
Fri	3	21 44 17 37 18 19	Conjunction of Moon and Jupiter, 2° 56′ S. Occultation of μ^1 Cancri (6) Reappearance of ditto			9 46·3
Sat	4	1 0 9 54	Conjunction of Moon and Uranus, 2° 44′ S. Near approach of γ Cancri (4½)	1st Sh. I. 1st Tr. I.	16 54 18 9	9 42·4
Sun	5	0 55	☾ Moon's Last Quarter Sun's Meridian Passage, 16m. 17·64s. before Mean Noon	1st Ec. D. 2nd Sh. I. 3rd Ec. D. 2nd Tr. I. 1st Oc. R. 2nd Sh. E.	14 9 26 14 53 16 58 29 17 26 17 41 17 46	9 38·5
Mon	6	12 51 13 36 14 29	Occultation reappearance of B.A.C. 3579 (6) Occultation of ι Leonis (6) Reappearance of ditto	1st Sh. I. 1st Tr I. 1st Sh. E. 1st Tr. E.	11 22 12 37 13 41 14 56	9 34·5
Tues	7			1st Oc. R. 2nd Oc. R.	12 9 15 4	9 30·6
Wed	8	19 23	Conjunction of Moon and Venus, 5° 50′ S.	1st Tr. E.	9 24	9 26·7
Thur	9			3rd Sh. E. 3rd Tr. I. 3rd Tr. E.	10 12 11 46 15 14	9 22·7
Fri	10			4th Tr. I. 4th Tr. E.	13 16 17 22	9 18·8
Sat	11			1st Sh. I.	18 47	9 14·9
Sun	12	5 8 14 35	● New Moon Conjunction of Moon and Mercury, 3° 18′ S.	1st Ec. D. 2nd Sh I.	16 2 34 17 26	9 10·9
Mon	13			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 16 14 27 15 35 16 47	9 7·0
Tues	14	5 16	Occultation of λ Sagitarii (3)	1st Ec. D. 2nd Ec. D. 1st Oc. R. 2nd Oc. R.	10 30 51 12 14 32 13 59 17 34	9 3·1
Wed	15	7 35 8 43	Conjunction of Moon and Mars, 0° 0′ Conjunction of Moon and Saturn, 1° 49′ N. Illuminated portion of disc of Venus=0·372 " Mars=0·937	1st Tr. I. 1st Sh. E. 1st Tr. E.	8 55 10 3 11 15	8 59·1
Thur	16	1 33 7 2	Conjunction of Saturn and Mars, 1° 47′ S. Occultation of h^2 Sagittarii (4½)	3rd Sh. I. 2nd Tr. E. 3rd Sh. E. 3rd Tr. I.	10 49 12 1 14 11 15 29	8 55·2

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Fri	17		Sidereal Time at Mean Noon, 15h. 44m. 24·65s.			Moon. — 4 40·8
Sat	18	20 46 7 3 7 49	☾ Moon's First Quarter Occultation of ε Capricorni (4½) Reappearance of ditto Saturn's Ring: Major Axis=34·85″ Minor Axis=10·16″	4th Ec. D. 4th Ec. R.	11 37 41 15 12 27	5 37·9
Sun	19		Sun's Meridian Passage 14m. 29·99s. before Mean Noon.	1st Ec. D.	17 55 44	6 30·4
Mon	20			1st Sh. I. 1st Tr. I. 1st Sh. E.	15 10 16 17 17 29	7 19·1
Tues	21	3 19	Near approach of 33 Piscium (5)	1st Ec. D. 2nd Ec. D. 1st Oc. R.	12 24 2 14 50 56 15 48	8 4·8
Wed	22			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	9 38 10 44 11 57 13 4	8 48·7
Thur	23			2nd Sh. I. 1st Oc. R. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E. 3rd Sh. I. 3rd Sh. E.	9 16 10 15 11 30 12 10 14 25 14 48 18 10	9 31·7
Fri	24	13 34 22 31	Conjunction of Venus and θ Virginis (1·3m.) E. Conjunction of Venus and θ Virginis 0° 6′ N.			10 15·0
Sat	25			2nd Oc. R.	9 14	10 59·2
Sun	26	13 53	○ Full Moon			11 44·8
Mon	27	10 10 11 23 13 55	Occultation of ι Tauri (5) Reappearance of ditto Near approach of 105 Tauri (6)	3rd Oc. D. 4th Tr. E. 3rd Oc. R. 1st Sh. I. 1st Tr. I.	8 58 9 42 12 28 17 4 18 6	12 32·1
Tues	28			1st Ec. D. 2nd Ec. D. 1st Oc. R.	14 17 17 17 27 20 17 35	13 20·8
Wed	29	19 55	Near approach of ω Geminorum (6)	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	11 32 12 32 13 51 14 52	B. Ceti. — 8 3·1
Thur	30			1st Ec. D. 2nd Sh. I. 1st Oc. R. 2nd Tr. I. 2nd Sh. E. 2nd Tr. E. 3rd Sh. I.	8 45 36 11 50 12 2 13 51 14 43 16 46 18 46	7 59·1
DEC. Fri	1	4 30 7 25 18 8 19 20	Conjunction of Moon and Jupiter, 2° 57′ S. Conjunction of Moon and Uranus. 2° 49′ S. Occultation of γ Cancri (4½) Reappearance of ditto	1st Sh. E. 1st Tr. E.	8 20 9 19	7 55·2

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN NOVEMBER, 1871.

By W. R. Birt, F.R.A.S.

Day.		Supplement ☾ — ☉ Midnight.		Objects to be observed.
		° ′		
14	...	148 12·1	...	Mare Smythii (*a*), Kästner Hecatæus.
15	...	134 24·9	...	Eimmart, Plutarchus, Seneca.
16	...	120 51·5	...	Strabo, Thales (*b*), Euctemon.
17	...	107 35·6	...	Lacus Somniorum, Mason Baily.
18	...	94 39·1	...	Maurolycus, Barocius Bacon.
19	...	82 2·2	...	Aratus, Mt. Hadley, Conon.
20	...	69 43.9	...	Birmingham (*c*), Goldschmidt (*d*), Challis, Main (*e*).
21	...	57 42·6	...	Fontenelle Region about the North Pole.
22	...	45 56·6	...	Pallas, Bode, Uckert (*f*), Triesnecker.
23	...	34 24·2	...	Bouguer, Louville, Censorinus (*g*).
24	...	23 3·6	...	Tobias Mayer (*h*), Oceanus Procellarum.
25	...	11 53·3	...	Harding, Repsold, Œnopedes.
26	...	0 51·7	...	Leibnitz Mountains Bouvard.

For additional objects consult the lists for July and September.

(*a*) Libration is bringing this fine formation on the west limb (marked by the late Dr. Lee, to commemorate the astronomical labours of the author of the Bedford catalogue) into a favourable position for observation. It may be well studied during the progress of the lunation.

(*b*) Thales is a fine ray centre, the epoch of the first appearance of the streaks should be determined.

(*c*) This formation the second westward from Fontenelle, which comes into sunlight later, is not on Webb's map, and so far as I am aware, is unnoticed by Bandell. Mr. Birmingham first called attention to it, and as he was the discoverer of T Coronœ, the appellation "Birmingham" will be the most suitable for it as commemorating the two discoveries. The formation is described under the title of Telescopic Work for Moonlight Evenings in the *Student*, July 1870, p. 323, and also in the *English Mechanic*, July 22, 1870, p. 418.

(*d*) A fine walled plain between Barrow and Anaxagoras, named by the late Dr. Lee to commemorate the discoveries of Goldschmidt.

(*e*) The two craters between Scoresby and Gioja have been named Challis and Main.

(*f*) Mr. Neison is now engaged in observing the region around Pallas, sketches of this interesting locality under every illumination are very desirable.

(*g*) Censorinus is vividly bright and seen under every illumination. Its degree of of brilliancy should be compared with those of Procus Dionysius, the surface around Kepler, and Aristarchus. The centre mountain of Aristarchus is reckoned as 10°, the surface around Kepler as 5°

(*h*) Tobias Mayer is a minor streak, centre in the neighbourhood of the great outburst from Copernicus.

Gassendi. Selenographical students will find in the *English Mechanic* for October 13th, 1871, p. 99, a plan of Gassendi with catalogue of referenced objects, which they will do well to identify, with the exception of 111 B, Sigma 31, and the clefts 28, 29, and 30, they may be seen with apertures under 6 inches.

THE AZTECS' CALENDAR STONE.

The American Minister to Mexico has forwarded Governor Baker, of Indiana, a valuable and curious contribution to the State library, in the shape of a model of the calendar stone of the Aztecs, the discovery of which shows how accurately those ancient people of Mexico measured the lapse of time. Mr. Nelson says the calendar stone was discovered on Dec. 17, 1790, not far from the centre of the principal square, and directly in front of the entrance to the palace. It was lying flat, with its sculptured side downward, and the upper part only 18 inches from the level of the ground. By order of the viceroy, and at the request of the authorities of the cathedral, it was delivered to them, on condition of being placed in some position easily accessible to the public.

The material of the calendar stone is an exceedingly hard basalt, found only at a great distance from the city of Mexico. It is 11 feet 8 inches in diameter, and about 2 feet 6 inches in thickness. The Aztec civil year consisted of eighteen months of twenty-five days each, to which were added five complementary days that were not considered as belonging to any month, and were regarded as unlucky by the Aztecs. At the expiration of each cycle of fifty-two years, twelve days and a half were interpolated to compensate for the six hours annually lost. The conclusion of each cycle was a memorable event in Aztec annals. The perpetual fires in the temple and all the fires in the private dwellings were extinguished; they destroyed much property, and literally "clothed themselves in sackcloth and ashes." At midnight of the first day of the new cycle imposing religious ceremonies were celebrated by the people *en masse*, including the sacrifice of human victims, and the lighting of a new fire by friction from a wooden shield placed on the breast of a victim. This fire was then communicated to torches borne by thousands of runners, who conveyed it to the remotest settlements of the Aztec empire.

Mr. Gallatin draws from the detailed examination of the hieroglyphics the following conclusion:—"We find, therefore, delineated on this stone all the dates of the principal positions of the sun, and it thus appears that the Aztecs had ascertained with considerable precision the respective days of the two passages of the sun by the zenith of Mexico, of the two equinoxes, and of the summer and winter solstices. They had, therefore, six different means of ascertaining and verifying the length of the solar year, by counting the number of days elapsed till the sun returned to each of these six points; the two solstices, the two equinoxes, and the two passages by the zenith."—*Antiquary*.

ENCKE'S COMET, NOVEMBER, 1871.

1871.		R.A. h. m s.		Decl. ° ′
Nov. 1	...	22 50 30	...	+38 4
3	...	22 30 44	...	37 10
5	...	22 10 32	...	35 58
7	...	21 50 10	...	34 29
9	...	21 29 56	...	32 43
11	...	21 10 5	...	30 41
13	...	20 50 48	...	28 26
15	...	20 32 15	...	25 59
17	...	20 14 31	...	23 24
19	...	19 57 37	...	20 43

1871.		R.A h. m. s.		Decl. ° ′
Nov. 21	...	19 41 32	...	17 59
23	...	19 26 14	...	15 13
25	...	19 11 39	...	12 28
27	...	18 57 46	...	9 45
29	...	18 44 29	...	7 4

ASTRONOMICAL REGISTER.—Subscriptions received by the Editor.

To Dec. 1871.
Benson, Rev. Dr.
Buffham, T. H.
Dix, F.
Hemming, Rev. B. F.
Jackson Gwilt, Mrs.
Lancaster, J. L.
Lancaster, W. L.
Rump, H. R.
Simkiss, T. M.
Wright, W. H.

To Feb. 1872.
Blacklock, A. W.

To March 1872.
Ingram, Rev. H.

To Dec. 1872.
Birt, W. R.

TO CORRESPONDENTS.

It is particularly requested that all communications be addressed to the Editor, Parnham House, Pembury Road, Clapton.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to John C. Jackson, at Lower Clapton, London, E.

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The pages of the *Astronomical Register* are open to all suitable communications. Letters, Articles for insertion, &c., must be sent to the Editor, *Parnham House, Pembury Road, Clapton, E.*, **not later than the 15th of the Month.**

The Astronomical Register.

No. 108. DECEMBER. 1871.

ROYAL ASTRONOMICAL SOCIETY.

Session 1871—72.

First Meeting, November 10th, 1871.

W. Lassell, Esq., F.R.S., *President,* in the Chair.

Secretaries—Dr. Huggins, F.R.S., and E. Dunkin, Esq.

The minutes of the last meeting were read and confirmed. One hundred and fifty-nine presents were announced, and the thanks of the Society were voted to the donors. Attention was particularly directed to a chart of the eclipse of 1724, the last total eclipse visible in England. This chart was drawn by Dr. Halley, and showed that London was just out of the totality.

The Astronomer Royal said he was not acquainted with this chart, but had read the description of the eclipse by Dr. Stukely, which was very interesting. Mr. Peyton, who presented the chart, said that it had been found in a book 144 years old, which had belonged to a Commissioner of the Navy.

Joseph W. Freeman, Esq.,
Robert H. W. Bosanquet, Esq., and
Harry Taylor, Esq.,

were balloted for, and duly elected Fellows of the Society.

The following papers were announced and partly read:—

Notes on the Construction of the Heavens, explanatory cf a Chart of 324,198 *Stars*: by Mr. Proctor.

Mr. Brothers exhibited a photographic negative of this chart, and stated that Mr. Proctor considered Argelander's Maps of the Northern Hemisphere superior to any former work of the same kind. In the preparation of the original chart, which was two feet in diameter, each division of 50 was covered up as soon as completed, in order to avoid any bias in favour of any plan. The work was continued without interruption, except for food and rest, in order that the style of mapping might not alter. Taking one minute for 10 stars, the chart should have occupied 540 hours, but it only took 400, and no change of style could be detected where the work ended, and where it began.

The Astronomer Royal said the chart was a work of great interest, but it struck him that the principal stars were rather too small to be distinguished. He had looked in vain for Vega, Arcturus, Capella, and the well-known configuration of Orion, Cassiopeia, etc.; and he thought if this could be altered, even now, it would be an improvement; at present it looked all star dust.

The President: I have felt this, too; I cannot find the Great Bear.

Mr. Brothers explained that if the scale of magnitudes had been larger, the stars would have encroached on each other. Already they nearly did so. It must be remembered that only stars down to the equator were included, so that the top star of Orion's belt was the limit of the stars in that constellation. If held properly, all the principal groups could easily be found.

Mr. Dunkin had readily picked out all the principal stars.

The President: Still it is not like the heavens where the stars do not seem so crowded.

Capt. Noble: If stars of the second and third magnitude had only been included, it would have been easy to make the chart more distinct; but, if the number included were considered, it was clear the scale did not allow of greater differentiation.

Mr. Brothers: The number shows that many more stars than can be seen with the naked eye are included; only a few thousand stars can ever be seen at once by the eye.

Col. Strange: This answers the objection; no eye ever saw what this chart displays.

Dr. Huggins: If the eye were a 2-inch telescope, it would see the stars here mapped, but not otherwise.

Observations of Encke's Comet: by the Astronomer Royal.

R. A. and N. P. D. of the same: by the same.

The comet, as described by Mr. Carpenter, was large and faint. The diameter of the brightest part was about equal to an interval of the wires used in eye and ear observations—that is, about 240″. The comet was somewhat fan-shaped, and had no nucleus. The places were taken of the brightest part, and the power used was 50.

		G. M. T.	R. A.	N. P. D.
		h m s	h m s	° ′ ″
Nov. 8	...	6 28 45	21 38 42·5	
			21 38 47·7	56 54 27
9	...	6 15 7	21 29 0·5	57 48 7

The Astronomer Royal added that the transit observations were made with difficulty, from the size of the comet being six or eight minutes, while the instrument was made for stars. He wished particularly to call attention to its peculiar form, which was a short parabola, and the direction of its axis with regard to the sun. He had requested Mr. Carpenter to draw it on the globe on the table, and it would be seen that the fan-shaped part was directed nearly towards the sun; its edge was a hard curved line on one side, but very ill-defined on the other towards the sun.

Dr. De la Rue: The tail, then, is turned towards the sun?

The Astronomer Royal: Yes, if you call it a tail. In R. A., too, the tail goes first. It has been examined in the great equatorial as well as the transit. The paper states that last evening it continued still the same. It is easily seen in the finder of the equatorial.

Dr. Huggins: I have been observing the comet for the last few nights, and quite confirm the general accuracy of Mr. Carpenter's drawing, but I should make it rather brighter in the central part. The nebulosity is cut off nearly in a straight line, as he describes it, and it extends a considerable distance. I see a minute stellar nucleus rather below the centre of the apex. On two evenings I have examined its spectrum. This is very faint indeed. Nearly the whole of the light is concentrated in one band in the less refrangible end, and nearly identical with *b*. This band could be traced for a short distance. I had also a suspicion of two other faint bands, one of which, coincided with the central band of the comet of 1868, which lines I found to be due to carbon vapour. I have since compared the comet's spectrum with the actual carbon bands, placing the spectrum of the comet between the carbon lines above and below, when the coincidence seemed complete, so far as it could possibly be observed, and the comet seems to have the same constitution as Winnecke's. The stellar nucleus is quite distinct, but very minute. The aperture of the telescope is 15 inches.

The President, referring to the drawings, thought that the fan was not so widely separated in his 2 ft. reflector as Mr. Carpenter showed. There was no nucleus, properly speaking, but only condensation in one place.

Dr. Huggins thought the comet, as seen by him, looked like Mr. Carpenter's drawing surrounded by a larger envelope.

Some further discussion took place as to the comparison between the drawings, which were ultimately proved to be quite similar.

Note of Warning to Stereoscopic Theorists: by Mr. Drach.

The author evidently meant *spectroscopic*, and not *stereoscopic*. He objects to founding any conclusions as to the existence of organic life in celestial bodies, on the gases discovered by the spectroscope in their atmospheres, and hopes that astronomy will not be directed to subjects "beyond our ken," and suggests that the gases present may have organisations adapted to them.

Occultations of Stars by the Moon: by Capt. Noble.

1871, Sept. 24. ϕ Capricorni disappeared instantaneously at the dark limb of the moon at 22h. 50m. 33·5s., L. S. T.=10h. 37m. 18·14s., L. M. T.

Power 154. Atmospheric undulation tremendous.

1871, Oct. 23. τ^1 Aquarii disappeared instantaneously at the dark limb of the moon at 22h. 49m, 44s., L. S. T.=8h. 42m. 27·5s., L. M. T.; and reappeared at the bright limb at 23h. 23m. 56s., L. S. T.—9h. 16m. 34s., L. M. T.

The motion was so oblique as to render the observations uncertain.

τ 2 Aquarii, a more conspicuous star, disappeared instantaneously at the dark limb of the moon at 23h. 57m. 27·8s., L. S. T. =9h. 50m. 0·2s, L. M. T.; and reappeared pretty sharply at the bright limb at 1h. 7m. 29·8s. L. S. T.=10h. 59m. 50·7s., L. M. T.. The limb was mountainous, boiling, and bubbling.

Power 255.

Note on the Inferior Conjunction of Venus: by Capt. Noble.

On Sept. 26, Venus was observed 1h. 37m. after she had passed her inferior conjunction. The atmosphere was bad, and the dark body of the planet was not visible in a constricted field, as it had been on former occasions.

Capt. Noble added that the last remark might be explained, by supposing the light background to be variable in lustre, as he had always before seen the dark outline.

The President enquired how near Venus was to the sun. He had seen it within 2½ diameters.

Capt. Noble could not answer exactly, but he had seen the planet nearer before, in fact, with the sun shining on the object-glass. His plan was to pierce a hole in a card diaphragm, with a red hot needle, and the card being fitted to the stop of the eye-piece, showed the dark body of Venus like the moon a few days old.

The President thought that Venus was at a considerable distance from the sun at this conjunction.

Mr. Lynn saw the planet all round at this very conjunction.

The Astronomer Royal, recurring to the subject of Encke's comet, remarked that he was probably the only person in the room who saw this comet in 1828. It was then nearly in opposition, and the form was totally different to its present shape, being then nearly circular. Struve, at Dorpat, with a larger telescope, also saw it of the same shape. Now it looked like one within another.

Mr. Dunkin: It was then 15 minutes in diameter.

Mr. Buckingham: And is now 7 minutes.

The President enquired whether the acceleration was still obvious.

The Astronomer Royal said it was not known yet.

Remarks on an Envelope of Red Matter, surrounding the Solar Photosphere: by Professor Grant.

This paper was devoted to showing that the author was the first to deduce, from the numerous observations of total solar eclipses before and since 1842, that in addition to the red prominences, there was a continuous layer of bright red matter, which was now called the *chromosphere*, and he explains by means of a diagram how the position of the arc of this covering generally seen, or the *sierra*, as it was frequently called, would vary according to the observer's place compared with one in which the eclipse was central. He also mentioned that on November 30, 1872, there would be an eclipse which it was calculated would be total at the beginning, annular in the middle, and total again towards the end; and he thought this would be a favourable opportunity for observing the chromosphere, which Secchi said was 13″ in thickness.

The Astronomer Royal explained that the eclipse would not vary in the manner described at any one place.

Mr. Ranyard observed that the observations of these streaks of light had been collected by Schmidt of Athens, and it appeared that this stratum was lower than the chromosphere, and might, perhaps, account for the reversed bright Fraunhofer lines seen by Professor Young and Mr. Pye.

The Astronomer Royal would call attention to the plates illustrating the account of the eclipse of 1851, in the Society's Memoirs, which showed a bright red sierra for 40 or 50 degrees; and he particularly remarked that the colour was not the same as that of the prominences, being a pale scarlet, while the others were lake, and he had no doubt this was the origin of the beautiful blush in the horizon on one side.

Mr. Dunkin said that his station at Christiana was on the northern limit; it was a good station for the purpose, but not being clear, he saw no sierra; a rose-coloured blush was, however, noticed by one of his assistants.

Mr. Penrose called attention to the great contrast to these observations found in Spain at the last eclipse. There was an utter absence of anything of the kind. The clouds continued till 40 seconds before the totality, and when he looked at the distant mountains, expecting some colour, he found a remarkable want of it; they were greenish brown, with no tendency to rose.

Les Variations de la Pesanteur dans les Provinces Occidentales de l'Empire Russe: by M. Sawitsch.

This was a paper on the observations of the remarkable change in the force of gravity in some parts of Russia, which would require study when printed.

Discovery of New Nebulæ: by M. Stephan.

This was a list of the places of a considerable number of new nebulæ found by the author with the large silvered glass reflector of the Marseilles Observatory.

The Rev. F. Howlett wished to mention that, while observing the sun with a spectroscope, on a very fine and tranquil afternoon in September, and while noticing the bright bands of hydrogen on the dull spectrum, he had been surprised by a beautifully brilliant prismatic stripe running from end to end of the spectrum. He then thought it might arise from thistle down, distant insects, or other terrestial bodies; but, subsequently, reading Mr. Proctor's last paper on the Corona, in the *Monthly Notices*, in which the author, quoting Zollner's account of some such flashes, thinks they may be connected with erupted matter, he was desirous of knowing the opinion of the fellows on the subject, and of asking whether the proportion the velocity of light bore to the diameter of the sun might have anything to do with it.

Mr. Gibbs did not know what the appearances were, but he had seen them frequently passing from the red to the yellow.

Mr. Browning exhibited *a Model of a Mounting for a Large Equatorial Reflector*, in which the Polar axis could be adjusted for different latitudes, almost from the Equator to the Pole. He said that, having been requested by the Astronomer Royal to alter the Equatorial Reflector, used by Major Tennant for photographing the eclipse of 1868, for the coming eclipse, and also for photographing the transit of Venus, he had done so, and been aided by Dr. De la Rue in his plan. He, however, thought he could do better in future, and made the model shown, to scale. In this, which he described in detail, the Polar axis could be raised from its horizontal position at the Equator to 60° without interfering with the connection to the driving clock. This he always made very large, to prevent it being run away with by the telescope. The model was made with a view to future operations; but, before it was completed, he had received an order from Mr. Collier, of Sydney, for a 10¼-inch reflector, which was first to be used in Australia, and then probably brought to England, so that his labour had at once become available. He was sure Mr. Collier would be happy to allow any competent observer the use of his instrument when he received it.

The Astronomer Royal said that formerly equatorials were made for observatories, but now they were adapted for flying expeditions. It was curious that this was not thought of when Major Tennant's was constructed. He also mentioned that Venus was now in a most favourable position for observation, and that, having laid down Bianchini's markings on a globe, neither Mr. Carpenter nor himself could see any of them.

The President: Neither have I.

Capt. Noble said that the *Observing Astronomical Society* had reported some marks.

Dr. Huggins said he had never been able to see anything like the markings of the early observers. Of course, there were some at the terminator, and, sometimes, he had fancied he saw a difference in brightness near the convexity, but the appearances were delusive.

Dr. De la Rue said that he had many times seen markings on Venus, and drawn them. They reminded him of Mars, but were much less distinct. When the atmosphere was good, he had generally seen them.

Col. Strange asked whether he had ever shown them to other persons.

Dr. De la Rue replied that it rarely happened he had anybody with him when observing, but he would bring the drawings.

Dr. Huggins said that on this morning he had seen some irregularities, as if the surface were pitted with little craterlets, like the moon.

Mr. Browning had seen these, too, and thought them real, but had seen no large markings.

Mr. Buckingham noticed, in 1865, at inferior conjunction, that three pieces seemed apparently wanting to complete the configuration, but he did not see any markings.

Dr. De la Rue made a rough sketch of the marks. They were best seen when Venus was gibbous.

Col. Strange enquired whether any medium had been used to subdue the glare?

Dr. De la Rue said, No. He observed with a reflector, and generally used a concave eye-glass.

Capt. Noble remarked that every one had seen the cusp cut off, and, if this were due to a mountain, there might be markings elsewhere; but, until Dr. De la Rue spoke, he had heard no trustworthy account of such being observed.

Dr. De la Rue said everyone had the right to doubt what he did not see himself. He remembered that, on sending his picture of Saturn to Sir J. Herschel, the latter wrote him a letter saying that if he could see the planet like that, he should die contented, but many had since seen, and testified to the accuracy of that drawing. Venus, like the moon, had darker parts, which interfered with the line of the terminator, but were not necessarily mountains.

On the Zodiacal Light: by Capt. Tupman.

This paper introduced a most valuable and careful series of drawings of the phenomenon, made by the author in the Mediterranean, which would be engraved for the publications of the Society, and deserved attentive study.

Mr. Ranyard called attention to the axis of the zodiacal light in these drawings, which did not coincide with the ecliptic, but often intersected it at enormous distances, even sometimes as much as 45° from the sun.

Errors in Logarithmic Tables: by Mr. Wackerbarth.

Observations of Saturn, Mars, &c.: by Mr. Spear.

On the Precession of the Equinoxes: by Mr. D'Oyley.

Observations of Solar Spots: by M. Beer.

On the supposed change of the Nebula round μ Argus: by Mr. Lassell.

This paper has already been printed in the *Monthly Notices.*

The meeting then adjourned.

DRAWINGS OF MARS.

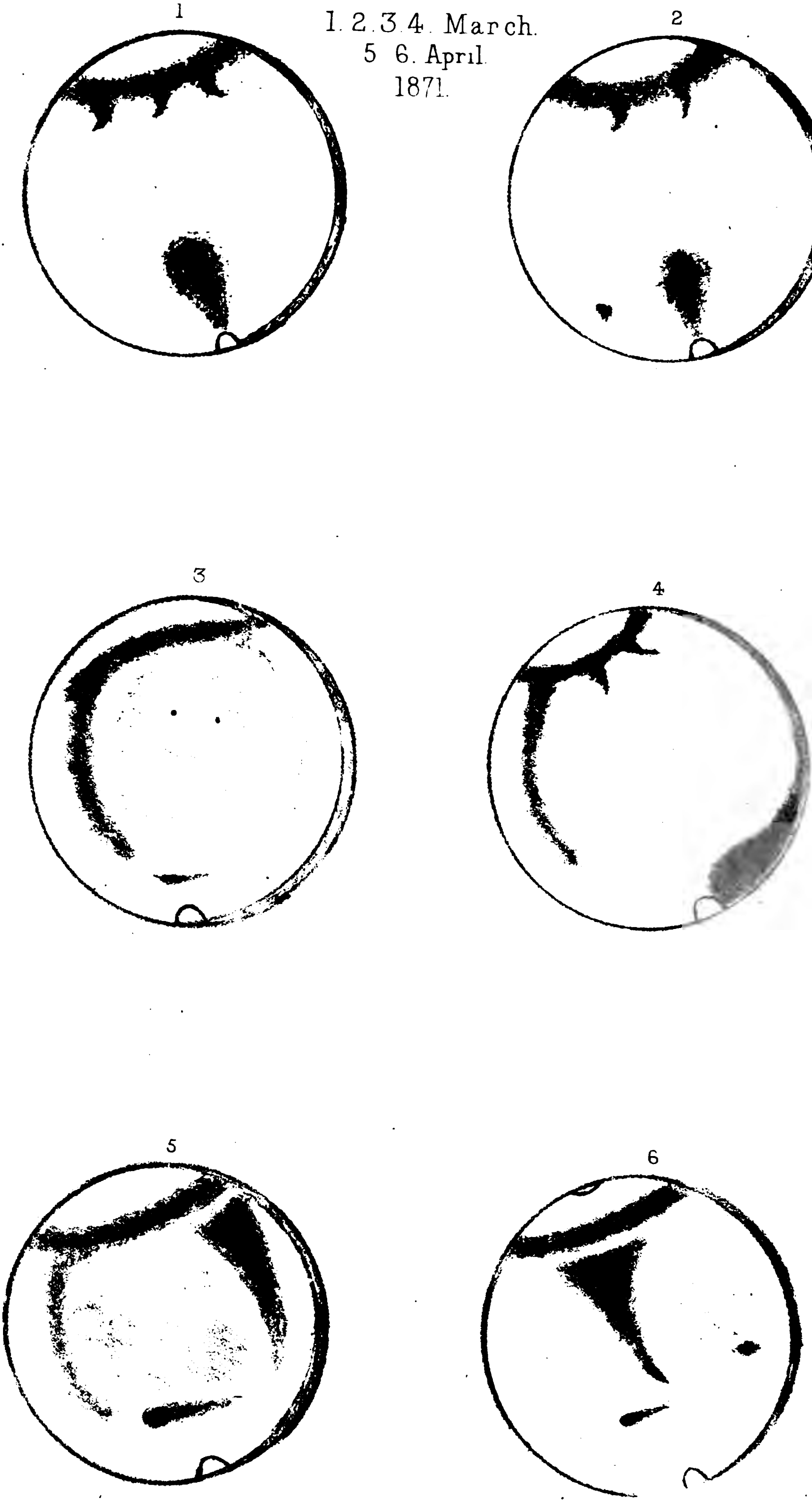
In the October number of the *Register*, a few remarks on the appearances seen on the disc of Mars were inserted, and reference was made to some lithographed sketches. Several observers having applied for copies of these rough drawings, a number has been printed for insertion in the *Register*. It is hoped that, rough as they are, they may be interesting to many who directed their telescopes to the planet in the spring of this year.

JOSEPH GLEDHILL, F.G.S., &c.

Mr. E. Crossley's Observatory,
Park Road, Halifax.

MARS

1. 2. 3. 4. March.
5 6. April.
1871.



CORRESPONDENCE.

N.B.—We do not hold ourselves answerable for any opinions, expressed by our correspondents.

TO THE EDITOR OF THE ASTRONOMICAL REGISTER.

JUPITER.

As early as the 9th of October, a very large dark spot was seen in the bright zone bounded by bands 2 and 3 (see *Register*, No. 88, 1870, for diagram), and connecting these bands together. On turning to the planet soon after midnight, Nov. 8th, other new objects caught the eye in this region. Band No. 3, which has not been a very well-defined streak for years, perhaps, had at this time three large dark spots upon it. The two western were the larger. In size and general appearance they closely resembled the dark forms which separate the bright ovals under No. 4. No. 1 was not visible. No. 5 was a very fine broad streak, very nearly as broad as No. 2 (the finest of all), but not so dark. This band was soft and flocculent in character. To the south of No. 5 no other distinct band could be detected. The cloudiness about the southern Pole was of a leaden hue, and much darker than that about the opposite polar region. The festoons under No. 4 were easily seen.

A little later the eastern third of band No. 3 did not shade imperceptibly into the central dark zone, but had a narrow bright space above it. As the planet rotated, this feature was soon seen to be a new band between Nos. 2 and 3. No. 2 now had a dark spot on its northern edge. No. 1 was now seen at the eastern edge of the disc.

At 3 a.m., Nov. 9th, a narrow and somewhat faint band began to appear to the south of No. 5. The new streak, which was now invisible on the west, appeared again in the east.

As far as observed, the striking changes on the disc, since the last apparition, may be thus described :—

1. No. 3 has now large spots upon it.
2. A new belt has appeared between Nos. 2 and 3.
3. A very large spot lies in the bright zone between Nos. 2 and 3, connecting them together.

During the winter of 1869-70 the southern regions seemed to be those of greatest change. At present the northern zones exhibit the most marked and extensive changes.*

JOSEPH GLEDHILL, F.G.S., &c.
Mr. Crossley's Observatory,
Park Road, Halifax.

Nov. 10, 1871.

* Several minor details are shown of the sketches made at the time. As our micrometer was at York under repair, no measures were taken.

JUPITER.

Sir,—The phenomenon described by Mr. Holden was, unquestionably, a most magnificent and stupendous one. Changes so vast, and so sudden, on the disc of Jupiter have rarely, if ever, occurred since telescopes have been directed to this noble planet. Unfortunately for us here, a gale was blowing on the 20th of February last, and so we are unable to confirm the statements of Mr. Holden. We ought to add, however, that the planet was never visible here without being carefully watched the whole night long with our 9½-inch refractor; and that no such appearances as those described by Mr. Holden were seen either before or after the date he gives.* Considerable changes have taken place since February last; and these, though not so vast as those mentioned above, will yet be readily detected on a careful scrutiny of the planet during one rotation.

I am, Sir, yours very truly,
JOSEPH GLEDHILL, F.G.S. &c.

Mr. E. Crossley's Observatory,
Park Road, Halifax:
November 14th, 1871.

* We observed the planet on February 21st and 25th, and brought our work to a close on the 8th of April.

OBSERVING ASTRONOMICAL SOCIETY.

OBSERVATIONS OF VENUS

Sir,—In your number for March last, page 63, I invited, on behalf of the above society, the assistance and co-operation of observers generally, in the carrying out of a systematic series of observations of the planet Venus, during one complete synodical revolution. These observations were proposed to be made in order to endeavour to obtain, if it were possible, a better knowledge of the nature and character of the dusky markings which have been occasionally seen to diversify the disc of the planet. It was also proposed to collect all former sketches and records of the appearance of the markings, so that a mass of data might be collected from which it would be possible to say, with some degree of certainty, their forms and degree of permanency. In response to our invitation, many observers, some of whom are in the possession of instruments of large aperture, promised their active assistance, and the result is that the planet has, on very many occasions, been subjected to a careful examination, and the forms and general appearance of the dusky streaks and markings delineated. In all, I have received fifty sketches of them; and now that Venus is again formally situated as a morning star, it is probable that this number will soon be considerably increased. That the markings are very faint objects, and very difficult objects, is evident from the sketches, which show dusky, cloudlike appearances of irregular forms. On several occasions, two observers have succeeded in obtaining observations on similar dates, and their representations of the spots are somewhat analogous; but, in respect to the details, a dissimilarity is found to exist. Considering, however, the difficulty of clearly tracing the exact outline of these faint appearances, it is not surprising that there should be some little discordance apparent in some instances. It is satisfactory though to know that the general form of the markings, as observed on the same evening by two observers, accord very fairly, thus proving that every reliance may be placed on the results obtained. It is not, however, only to the workings on the planet's surface that the attention of the observers has been directed, but also to the irregular appearance of the outline of the terminator. This has been often detected; and, on some occasions, the positions and extent of the inequalities have been noted. In examining this planet, observers should be careful to scrutinise the terminator, so that if any irregularities are visible they may come under observation.

It is intended to continue the observations (which commenced on March 20 of the present year) until October, 1872, and effectually accomplish the collection of all previous drawings and records of this planet; the

Society will necessarily require the assistance of amateur observers and others, who may have in their possession any sketches or results of observations of the markings. It will also be very necessary to consult the works of the earlier observers, so that all the data possible may be collected and placed before a thoroughly competent astronomer, who will carefully subject it to a careful investigation, and decide as to the character and forms of the dark streaks and markings, which have been for so many years supposed to be utterly invisible to any but the most powerful telescopes. Now, however, that they have been undoubtedly and frequently seen with the aid of instruments of very moderate aperture, it is not improbable that they will be more generally looked for; and that, as a consequence, their forms, degree of visibility, and permanency will be better understood.

I shall be glad if those of your readers, who possess any observations or sketches of the planet, will send me all or a portion of the particulars of them, so that they may be compared with the other results. By doing this they will be materially aiding the Society in its endeavour to advance our astronomical knowledge. I shall also be pleased if any gentlemen, who have not previously expressed their willingness to assist us by making observations of the planet, will undertake to occasionally do so, and forward the results to me.

It will be interesting, perhaps, to describe some of the observations that have already been made. I am of this opinion because, of late years, there has been but little said in reference to the markings :—

1871.—April 22, 8h. 15m. Three elongated markings observed running parallel to the planet's equator. From the sketch, it would seem that they are not altogether unlike the belts of Jupiter—8¼ in. O.G.

May 1, 8h. 25m. Two dusky markings on the eastern part of the disc —8¼ in. O.G.

May 7, 7h. 55m. One large cloudlike object observed on the disc. It extended over nearly one-half of the illuminated portion of the planet's surface, running from N. to S., and was most intense a little N. of the centre of the disc—8¼ in. O.G.

May 10, 8h. The planet was clear and well-defined. They reminded Mr. Ormesher, who observed them, of the dusky spots of Mars, as they had much the same appearance. One large spot was in the E. part of the disc, and two other elongated markings or streaks were noticed running from N. and S., and a little from the centre—5¼ in. O.G. power 181.

May 12, 8h. A dark, faint object observed a little E. of the centre of the disc. From this sketch, and indeed from most of the others, it would appear that the edges of the cloudy markings fade away gradually, and not terminate abruptly, with a well-marked outline as in the case of the penumbra of solar spots—8¼ ir. O.G.

May 12, 8h. 15m. A very peculiar, large marking observed. It was somewhat similar in form to an X, and some portions of it were traced nearly up to the terminator. The centre of this irregular marking was a little W. of the middle of the illuminated portion of the disc—8¼ in. O.G.

May 18, 8h. 15m. Three spots of irregular outline visible. Some parts of these spots were much darker than others, and, consequently, much more conspicuous—8¼ in. O.G.

May 21, 1h. 30m. to 2h. 50m. 47s. In addition to two small streaks which were perceptible, the terminator was very irregular, there being a large projection from it—a little from the centre of the disc. One of the markings was very pale, the other situated slightly S. of the planet's centre, was more distinct—5¼ in. O.G. p. 181.

May 22. Two large irregular markings perceptible—8¼ in O.G.

May 24, 8h. 45m. One cloudy object. Object of irregular form seen near the centre of the illuminated part of the disc—8¼ in. O.G.

May 29, 9h. 30m. The markings very similar in form to those seen on May 10. 8h. The largest which was E. of the two others was rather pale—5¼ in. O.G. p. 181.

May 30, 8h. 30m. A large, elongated, and slightly curved marking seen on the E. limb. Two smaller spots near the terminator. One of these, a little S.W. of the centre of the disc, was traced up to the terminator.

June 2, 8h. One large marking seen on the E. limb. It was somewhat similar in form to the Greek letter ε. 13in. refl. The planet was also observed on this date by another observer, whose sketch shows a large elongated marking on the E. limb. The two sketches do not agree, however, in some of the details—8¼ in. O.G.

June 4, 8h. 15m. Large elongated marking seen in proximity to the E. limb. On various other portions, faint dusky spots were noticed.

June 6, 8h. 40m. Two large cloudy spots seen. They appear to be somewhat similar in their form to those observed on May 22—8¼ in. O.G.

June 11, 8h. 30m. Six dusky spots seen. They were much larger than those seen on June 4, 8h. 15m. One of them could be traced up to the terminator. Another representation of this planet shows it with three spots near the terminator, and a large broken ring, of elliptical form, with a faint marking in the centre, nearer the E limb. This ring presents a somewhat analogous appearance to one of the incomplete craters of the moon. A third observer also sketched the planet on this date, and says, "Definition extremely good. The markings were very clearly seen, and bore a very remarkable resemblance to the craters and inequalities of the moon as seen with a low power, say an opera glass. In this sketch the large marking appears to be constituted of small streaks of curved or spiral outline. The same appears to be the case with regard to some representations, by Mr. T. H. Buffham, of the planet's appearance in 1868, which are figured in the *English Mechanic*, No. 345, p. 172.

June 26, 7h. 45m. to 8h. Nearly the entire illuminated portion of the disc appeared to be clouded by a faint dusky covering. Mr. F. Worthington observed that the southern cusp was notched, and appeared very white—13 in. refl. p. 118.

July 1, 8h. 50m. A large spot which "looked like a dark cloud, and stood out boldly," was observed on this and several successive evenings at about the same time—3 in. O.G. p. 130.

July 17, 6h. 30m. Mr. H. W. Hollis, with his 6 in. O.G. p. 150, saw "the rounding off of the S. cusp very distinctly, and the prolongation of the N. one was more remarkable than he had ever before observed it. A dusky, ill-defined, and uncertain shaped spot was visible. On the 18th at 5h. 15m. he inspected the presence of this spot again somewhat nearer to the terminator; but of this I cannot speak positively."

August 7, 6h. The Rev. T. W. Webb writes: "The surface seems in best moments clouded with feeble grey markings, but they are too faint to be distinctly made out. Terminator faint. I do not see any irregularity in it. August 8, 6h. With p. 200. I thought there was something at N. horn. At first it seemed prolonged by a feeble twilight; afterwards I could not make that out, but I fancied there was a bright knot at the cusp, though it remained doubtful. I had, however, the same impression of a knot there with single lens, p. 270."

The above is a summary of a portion of the results obtained; but, without the sketches themselves, it is impossible to convey a correct impression as to the forms and appearance of the markings which I have briefly described above. Observers agree in stating that they are very faint cloudlike objects. I believe that it has been stated, the late Rev. W. R. Dawes never saw them, although possessed of very excellent vision, as regarded the observation of faint stars. No doubt a satisfactory reason for this can be given. In *Celestial objects*, p. 50, in treating of the markings, Mr. Webb says, that during observations of this planet at Rome, 1839-41, the most successful of six observers in detecting "these faint clouds were those who have most difficulty in catching very minute companions of large stars." "Debico assigns no reason, but it is obvious enough. A very sensitive eye, which would detect the spots more readily, would be easily overpowered by the light of a billiant star, so as to miss a minute one in its neighbourhood." This opinion is strengthened by the fact that most of the observations of the spots, mentioned in the summary, were made with the same telescope that was formerly in the possession of Mr. Dawes. This instrument is now erected at the Temple Observatory, Rugby; and, in the hands of Mr. George M. Seabroke, is doing some good work. The most successful of the other observers are Messrs. F. Worthington and Mr. Henry Ormesher. I shall have pleasure in sending you further particulars as the observations progress.

I am, Sir, yours truly,

WILLIAM F. DENNING, Hon. Sec.

It is worth noting that neither Sir G. B. Airy nor Dr. Huggins have detected any of these markings, though they have carefully looked for them.—Editor.

PROCTOR'S CHART OF 324,198 *STARS.*

Sir,—Will you permit me to make some remarks on an objection urged by the Astronomer Royal against my chart of 324,198 Stars? Mr. Airy seems to have supposed that this chart was intended to aid the observer in the search for individual stars; and, so viewing the matter, objected, very properly, to the circumstances that even the constellations are but barely recognisable. Nothing, however, could have been farther from my thoughts,—nothing, I may say, farther removed from the possibilities of charting—than the construction of a star-seeker's chart, in a 2-feet circle, to contain 324,198 stars. I have, indeed, had in view, as a secondary purpose of my chart, its use in showing observers where the rich regions of the heavens lie; and, in order that it might subserve this purpose, as well as my primary purpose, without being defaced, I added the photo-lithographed key-maps. I need scarcely point out how these, used with the photographic chart, show where the constellations fall in the latter; nor, again, is it necessary to show that if Mr. Airy's plan could possibly have been adopted, *i. e.*, if the leading stars could have been made sufficiently conspicuous, without obliterating a few hundreds of suns, I should have preferred that plan to the expensive one of adding a key-map.

But my primary purpose, in constructing the chart, was to obtain new evidence respecting the constitution of the sidereal heavens; and such evidence the chart does unquestionably afford. It shows that there is a condensation of stars of the leading orders of magnitude (to H's 11th magnitude) on precisely those regions where ♅ found the lower orders (from 12th to 18th) most densely congregated. This relation, unsuspected by ♅, denied by H, and partially recognised, but misunderstood by Σ, is exhibited in my chart, in a manner there is no mistaking.

The consequences of the relation are of extreme importance, for unless the multiplied coincidences noted are purely accidental (which no one will assert), there must be, in the clustering aggregations, a real mixture of orbs, of all degrees of size, from relatively very large ones, to relatively very small ones. The distinction between this result and the *various views* of ♅, H, and Σ will only be recognised by the few who care to study the subject of stellar distribution in space; it is, however, an important one.

I would submit that it is a trifle hard, after I have given some 400 hours of time to work out a sufficiently definite purpose, that my work should be found fault with, because it does not subserve a purpose I have never contemplated—a purpose, too, which no single chart can possibly subserve. I am reminded of a singular objection urged by the Astronomer Royal against my New Star Atlas—viz., that the maps do not admit of being fixed to a spindle-shaped block rotating on a polar axis. As the famous Mr. Dick defended his room against the observation that "he could not swing a cat there," by the plea that "he didn't *want* to swing a cat," so my answer naturally was, that I had never proposed to have my Atlas Maps "fixed to a spindle-shaped block," &c. A like answer avails in the case of my chart of 324,198 stars.

RICHARD A. PROCTOR.

Brighton: November 15th, 1871.

THE TOTAL ECLIPSE IN DECEMBER NEXT.

To the Editor of the *Times.*

Sir,—Observers of total eclipses of the sun seem to pay but little attention to the fact that probably there exists a hitherto unknown planet which revolves in an orbit interior to that of Mercury. Such a body, if it does exist, could be well detected during the progress of a total solar eclipse, if the region of the sky in the neighbourhood of the sun was very carefully examined. It may be in the recollection of some of your readers that, on the occasion of the eclipse of August 7, 1869, a bright object was seen by several observers in close proximity to the solar orb, and it is not improbable that this was actually the planet which Lescarbault, on March 26, 1859, witnessed in transit. It is true that observations made of late years, with the special object of detecting this suspected planet in transit over the sun's disc, have been unsuccessful, no object presenting an analogous appearance to a planetary body having been observed passing over the solar surface. This fact, however, does not prove the non-existence of the planet, and it is advisable that observers of the forthcoming eclipse carefully scrutinise the neighbourhood of the sun at the time of totality, so that it may be rediscovered if possible. Several observers of note have, on various occasions, witnessed the partial transit of opaque planetary bodies across the sun, and it does not seem altogether improbable that these bodies are intra-mercurial planets, which, from their proximity to the sun, could never be discerned, except when in transit, or at the time of a total solar eclipse. It is to be hoped that at the time of the approaching eclipse this fact will be considered, and a rigorous search made for the supposed planets, so that they may be discovered, and an increase to our knowledge effected.

I have the honour to be, Sir, your obedient servant,

WILLIAM F. DENNING, Hon. Sec,
Observing Astronomical Society.

Hollywood House, Cotham Park,
Bristol: November 2.

In reference to the foregoing, Mr. William F. Denning has forwarded us the following:—"I have received from two different observers accounts of observations of planetary spots passing over the sun. I do not think these observations have ever been published, and so send them to you for publication, thinking that they may prove interesting, although I cannot vouch for their authenticity. On August 1, 1858, 4h., Mr. Robert Wilson, of Manchester, observed the partial transit of a circular opaque body over the sun. He watched it from 4h. to 5h. 30m., when the observation was interrupted. Its motion was from east to west, across the solar disc, and it presented an appearance very analogous to a planet in transit. The other observation is by Mr. William Waite, of London, who, in a letter to me, states:—'It may interest you to know that, some years ago, I saw, what I suppose must have been, a planetary body in transit across the sun. A dark speck in the lower limb of the sun caught my eye just about sunset; thinking it to be a sun spot, I got a glass to look at it, but found it to be a globular body of the apparent bigness of an ordinary sized marble, and intensely black. I had not time to notice in which direction it was moving, as the sun dipped almost immediately. Unfortunately, I am unable to recollect what year it was in, but it must have been between June, 1860, and June, 1863, and I imagine the season was either spring or autumn, as the house fronted nearly due west, and the sun was setting just opposite. If such things have been seen, they may be seen again; and every additional observation tending to increase such probability leads me to trouble you with this rather lame tale.' It is hardly necessary for me to comment on the foregoing, so I leave your readers to form their own opinion as to what amount of reliance it is entitled to. I would remark, however, that the expression (in regard to the object seen by Mr. Waite) as to its size, is a rather vague one. With reference to the object seen by Mr. Wilson, it would seem that it could not have been the planet that was seen by Lescarbault, inasmuch as it was seen in August 1, whereas it would appear that the latter body can only be observed in transit during the intervals from March 20, April 10, September 27, and October 14, that is, if the rough date supplied by Lescarbault is reliable."

WILLIAM F. DENNING.

SUN.

Greenwich, Noon. 1871.		Heliographical longitude of the apparent centre			Heliographical latitude of the sun's disc.		Angle of position of the sun's axis.
Dec. 1	...	210°·86	—31 δ ξ	...	+0°·64 N	...	16°·10
2	...	224·06		...	0·51	...	15·71
3	..	237·25	—29 δ ξ	...	0·38 N	...	15·31
4	...	250·44		...	0·25	...	14·91
5	...	263·64		...	+0·12 N	...	14·50
6	...	276·83		...	0·00	...	14·08
7	...	290·02		...	—0·13 S	...	14·66
8	...	303·21		...	0·26	...	13·24
9	...	316·41		...	0·39	...	12·81

10	329·60	−22 δ ξ	−0·52 S	12·37
11	342·79		0·64	11·93
12	355·98		0·77	11·49
13	9·17		0·90	11·04
14	22·36		1·03	10·59
15	35·55		1·15	10·13
16	48·74		1·28	9·67
17	61·93	−15 δ ξ	1·41 S	9·21
18	75·11		1·53	8·74
19	88·30		1·66	8·27
20	101·49		1·78	7·80
21	114·68		1·91	7·33
22	127·87		2·03	6·85
23	141·06		2·15	6·37
24	154·25	−8 δ ξ	2·28 S	5·89
25	167·43		2·40	5·41
26	180·62		2·52	4·92
27	193·81		2·64	4·44
28	206·99		2·76	3·95
29	220·18		2·88	3·46
30	233·37		3·00	2·98
31	246·55	− δ ξ	−3·11 S	2·49
'72 Jan 1	259·74		−3·23 S	2·00

MOON'S TERMINATOR.

Greenwich, Midnight		60°N.	0°	60° S.
			Sunset.	
		°	°	°
1871. Dec.	1	+33·4	+32·8	+32·2
	2	21·1	20·6	20·1
	3	+9·0	+8·5	+8·0
	4	−3·2	−3·7	−4·1
	5	15·4	15·8	16·2
	6	27·7	28·0	28·3
	7	39·9	40·2	40·5
	8	52·1	52·4	52·6
	9	−64·3	−64·5	−64·7
			Sunrise.	
	15	+42·4	+42·3	+42·2
	16	30·3	30·1	30·0
	17	18·2	18·0	17·8
	18	+6·1	+5·8	+5·6
	19	−6.0	−6·3	−6·5
	20	18·1	18·5	18·8
	21	30·2	30·6	31·0
	22	42·3	42·8	43·2
	23	54·4	54·9	55·4
	24	66·4	67·0	67·5
	25	−78·5	−79·1	−79·7

SUNSET.

27	...	+75·9	...	+76·6	...	+77·3
28	...	63·7	...	64·4	...	65·2
29	...	51·5	...	52·3	...	53·1
30	...	39·3	...	40·2	...	41·0
31	...	+27·2	...	+28·0	...	+28·9

VARIABLE STARS.

1871.	G. M. T.* h. m.	Star			mag.		Place of Star 1855. A. R. h. m. s.	Decl. ° ′
Dec. 3	5 7	Algol	...	min.				
4		U Virginis	...	—			12 43 45	+6 20·6
13	12 7	S Cancri	...	—	10	...	8 35 39	+19 33·2
14	17 0	Algol		—				
17	13 8	Algol		—				
18		T Piscium	...	max.	9·5	...	0 24 29	+13 48·0
20	10 7	Algol	...	min.				
23	7 5	Algol	...					
—		R. Persei	...	max.	8	...	3 20 50	+35 10·1
—		R. Leporis	...	min.	9	...	4 53 0	—15 1·7
24		R Arietis	...	min.	12·5	...	2 7 53	+24 22·9
25		S Vulpeculæ	...	—	9·5	...	19 42 27	+26 55·7
26	4 3	Algol	...	—				
27		R Sagittæ	...	—	10·0	...	20 7 27	+16 17.4
Jan. 1	12 0	S Cancri		—				

The new Variable in A. R. 23h. 13m. 13s. decl. + 8° 7′ 5″, f. 1855, mentioned at p. 223, appeared on Nov. 6, of about 7m. 5s. Will not some observers, who have the means, please watch its changes?

JUPITER.

G. M. T.		Zenographical longitude | latitude of the centre of ♃'s disc. 8h.	10h.	12h.	14h.	16h.		Angle of pos. of ♃'s axis. 12h.		13h.
1871.		°	°	°	°	°		°		°
Dec. 1	...	9	82	154	227	300	...	0·96N.	...	13·83
2	...	160	233	305	18	90				
—										
3	...	311	24	96	169	241				
4	...	102	174	247	319	32				
5	...	253	325	38	115	183				
6	...	43	116	189	261	338	...	0·95	...	13·72
7	...	194	267	339	52	125				
8	...	345	58	130	203	275				
9	...	136	209	281	354	66				
—										
10	...	287	359	72	145	217				
11	...	78	150	223	295	8	...	0·95	...	13·58
12	...	229	301	14	86	159				
13	...	19	92	165	237	310				
14	...	170	243	315	28	101				
15	...	321	34	106	179	251	...			
16	...	112	185	257	330	42	...	0·95	...	13·41
—										

17	...	263	335	48	120	193		
18	...	54	126	199	271	344		
19	...	205	277	350	62	135		
20	...	355	68	141	214	286		
21	...	146	219	291	4	77	... 0·95	... 13·22
22	...	297	10	82	155	227		
23	...	88	161	233	306	18		
24	...	239	312	24	97	169		
25	...	30	102	175	247	320		
26	...	181	253	326	38	111	... 0·95	... 13·00
27	...	331	44	117	189	262		
28	...	122	195	267	340	53		
29	...	273	346	58	131	203		
30	...	64	137	209	282	354		
31	...	215	287	0	73	145	... 0·95N....	12·77

The longitudes are reckoned from the meridian, which on Dec. 31 at midnight appear directed to the earth. The assumed rate of daily rotation is 870°·72. The position of the planet's equator is assumed in accordance with Dàmoiseau's tables.

LUNAR OBJECTS SUITABLE FOR OBSERVATION IN DECEMBER, 1871.

By W. R. Birt, F.R.A.S.

Day.	Supplement ☾ — ☉ Midnight.		Objects to be observed.
	° ′		
14* ...	140 9·2	...	Neper, Schubert, Mare Australe.
15 ...	126 36·4	...	Berzelius, Schumacher, Trallis.
16 ...	113 23·7	...	Borda, Colombo, Cook.
17 ...	100 38·9	...	Mutus. Manzinus, Schomberger.
18 ...	88 19·5	...	Simpelius, Pentland, Jacobi.
19 ...	76 32·2	...	Malapert, Curtius, Zach.
20 ...	64 46·8	.	Mount Bradley, Boscovich, Bessell.
21 ...	53 26·7	...	Reinhold, Landsberg, Longomontanus.
22 ...	42 19·4	...	Gassendi (*a*), Doppelmayer, Letronne.
23 ...	31 21·3	...	Gay Lussac, Carpathian Mountains.
24 ...	20 29·6	...	Marius, Remer, Hansteen.
25 ...	9 41·5	...	Drebbel, Fourier, Wiegel.
26 ...	—1 5.2	...	Eichstadt, Gerard, Lavoisier.

For additional objects consult the lists for August and October.

* Autumnal Equinox, N. hemisphere.

(*a*) Gassendi. See notice in list for November, *ante*, p. 270.

Plato.—It is desirable to examine the floor with instruments of larger aperture than 9 inches. A minute spot just west of the principal spot No. 1. was seen by Mr. Gledhill with 9⅓ inches aperture, in January, February, and March, 1870. He does not appear to have seen it since the 13th of March in that year, when he described it as an easy object.

Errata.

October 28. For *rock*, read *rook*. Fourth line from 28, for *part of* read *parts of.*

November. For *Œnopedes*, read *Œnopides*. Note (*c*). for *Bandell*, read *B and M*. Note (*g*). for *Procus*, read *Proclus*.

ENCKE'S COMET.

This object is passing beyond reach of telescopes, owing to its approach to the sun. The following positions given by Glasenapp are not very exact; they place the comet about ½° too much to the N.

1871.		R.A. h. m. s.		Decl. ° ′
Dec. 1	...	18 31 46	...	+4 28
3	...	18 19 35	...	+1 55
5	...	18 7 56	...	—0 32

OCCULTATION OF VESTA.

Mr. Hind, in a letter to the *Astronomische Nachrichter*, notes that on Dec. 30, Vesta will be occulted by the moon. He does not remember to have met with any observed occultation of a minor planet. For Greenwich the circumstances on Dec. 30 are as follows:

		h. m.		°
Immersion	...	10 44	...	89 N. P. Aagle.
Emersion	...	11 51	...	240

New Comet.—A new comet was discovered by M. Tempel, at Marseilles, on November 3. The comet which was round and about 2½′ in diameter, was at the time of its discovery passing southwards out of reach.

The following positions may be acceptable to some of our readers residing out of England:

1871.		R.A h. m. s.		Decl. ° ′
Dec. 1	...	18 50 6	...	—34 2
5	...	18 51 36	...	37 4
9	...	18 52 30	...	—40 2

The following elements, calculated for direct motion, are by M. Ofpolzer:

		°
Perihelion Passage	Dec. 20 =	115 B.M.T.
Longitude of Perihelion	=	22 25
Longitude of Ascending Node	=	145 19
Inclination	=	102 7
Log. q.	=	9·87628

These elements resemble those of more than one previous comet, but they are too provisional to make it safe to draw any conclusions.

A New Observatory.—We hear that Professor Alluard, of Clermont-Ferrand, has obtained a grant of the necessary fnnds for establishing his long projected Observatory on the summit of the Puy-de-dome.

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m. Aldebaran
Fri	1	18 8 19 20 4 30 7 25	Occultation of γ Cancri (4½) Reappearance of ditto Conjunction of Moon and Jupiter, 2° 57′ S. Conjunction of Moon and Uranus, 2° 44′ S.	1st Sh. E. 1st Tr. E.	8 20 9 19	— 11 47·1
Sat	2		Sidereal Time at Mean Noon, 16h. 43m. 33s.	2nd Oc. R.	11 57	11 43·1
Sun	3	17 32 18 48	Occultation of 42 Leonis (6) Reappearance of ditto			11 39·2
Mon	4	18 45	☾ Moon's Last Quarter	3rd Ec. D. 3rd Ec. R. 3rd Oc. D. 3rd Oc. R.	8 50 40 12 5 47 12 30 16 0	11 35·3
Tues	5		Sun's Meridian Passage, 9m. 17·84s. before Mean Noon	4th Ec. R. 4th Oc. D. 1st Ec. D. 4th Oc. R.	9 20 15 14 10 16 10 37 18 21	11 31·3
Wed	6			1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	13 26 14 20 15 45 16 29	11 27·4
Thur	7	16 35 17 17	Occultation of 80 Virginis (6) Reappearance of ditto	1st Ec. D. 1st Oc. R. 2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	10 38 57 13 49 14 23 16 10 17 17	11 23·5
Fri	8	5 22	Conjunction of Moon and Venus, 1° 51′ S. Saturn's Ring: Major Axis=34·29″ Minor Axis=14·83″	1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	7 55 8 46 10 14 11 6	11 19·5
Sat	9	18 19 19 13	Occultation of ζ^1 Libræ (4) Reappearance of ditto	1st Oc. R. 2nd Ec. D. 2nd Oc. R.	5 7 21 9 22 24 13 59	11 15·6
Sun	10		Conjunction of Mercury and λ Sagittarii (12·8m) W. Conjunction of Venus with κ Virginis (3·8m.) E.			11 11·7
Mon	11	16 1 15 45	● New Moon Eclipse of the Sun, invisible at Greenwich Conjunction of Saturn and Mercury, 2° 26′ S.	2nd Tr. E. 3rd Ec. D. 3rd Oc. R.	8 15 12 48 41 19 27	11 7·7
Tues	12	23 30	Conjunction of Moon and Saturn, 2° 4′ N.	1st Ec. D.	18 4 3	11 3·8
Wed	13	2 1	Conjunction of Moon and Mercury, 0° 16′ S.	4th Sh I. 1st Sh. I. 1st Tr. I. 1st Sh. E. 4th Sh. E. 1st Tr. E.	13 48 15 20 16 6 17 39 17 41 18 25	10 59·8
Thur	14	5 6	Conjunction of Moon and Mars, 1° 57′ N.	1st Ec. D. 1st Oc. R. 2nd Sh. I. 2nd Tr. I. 2nd Sh. E.	12 32 25 15 34 16 57 18 28 19 51	10 55·9
Fri	15		Illuminated portion of disc of Venus=0·545 " Mars=0·954	3rd Tr. E. 1st Sh. I. 1st Tr. I. 1st Sh. E. 1st Tr. E.	9 9 9 49 10 32 12 8 12 52	10 52·0
Sat	16			1st Ec. D. 1st Oc. R. 2nd Ec. D.	7 0 50 10 0 11 58 46	Moon. — 4 22·5

DATE.		Principal Occurrences.		Jupiter's Satellites.		Meridian Passage.
		h. m.			h. m. s.	h. m.
Sun	17		Sidereal Time at Mean Noon, 17h. 42m. 41·37s.	1st Sh. E.	6 36	5 15·2
				1st Tr. E.	7 18	
Mon	18	8 41	☾ Moon's First Quarter	2nd Tr. I.	7 36	6 2·8
		9 0	Occultation of 30 Piscium (5)	2nd Sh. E.	9 9	
				2nd Tr. E.	10 31	
		10 2	Reappearance of ditto	3rd Ec. D.	16 47 23	
Tues	19		Sun's Meridian Passage 3m. 46·31s. before Mean Noon.	1st Ec. D.	19 57 36	9 47·7
Wed	20	12 49	Occultation of ν Piscium (4½)	1st Sh. I.	17 14	7 31·0
				1st Tr. I.	17 51	
		13 23	Reappearance of ditto	1st Sh. E.	19 33	
Thur	21			1st Ec. D.	14 25 59	8 14·0
				1st Oc. R.	17 19	
				2nd Sh. I.	19 32	
Fri	22			3rd Tr. I.	9 ·0	8 57·5
				4th Oc. R.	9 15	
				3rd Sh. E.	10 8	
				1st Sh. I.	11 43	
				1st Tr. I.	12 17	
				3rd Tr. E.	12 31	
				1st Sh. E.	14 2	
				1st Tr. E.	14 37	
Sat	23			1st Ec. D.	8 54 26	9 42·2
				1st Oc. R.	11 45	
				2nd Ec. D.	14 35	
				2nd Oc. R.	18 35	
Sun	24	18 11	Occultation of ι Tauri (5)	1st Sh. E.	8 30	10 28·6
		19 2	Reappearance of ditto	1st Tr. E.	9 3	
Mon	25			2nd Sh. I.	8 49	11 16·8
				2nd Tr. I.	9 51	
				2nd Sh. E.	11 43	
				2nd Tr. E.	12 46	
Tues	26	9 34	○ Full Moon			12 6·1
Wed	27			2nd Oc. R.	7 43	12 56·0
				1st Sh. I.	19 8	
Thur	28	5 18	Occultation of μ^1 Cancri	1st Ec. D.	16 19 41	13 45·5
		6 8	Reappearance of ditto	1st Gc. R.	19 3	
		6 6	Conjunction of Moon and Jupiter, 2° 41' S.			
			Conjunction of Moon and Uranus. 2° 43′ S.			
			Saturn's Ring: Major Axis=34·04 Minor Axis=14·49			
Fri	29			3rd Sh. I.	10 41	Aldebaran — 9 56·9
				3rd Tr. I.	12 19	
				1st Sh. I.	13 37	
				1st Tr I.	14 1	
				3rd Sh. E.	14 7	
				3rd Tr. E.	15 49	
				1st Sh. E.	15 56	
				1st Tr. E.	16 21	
Sat	30			4th Sh. I.	7 47	9 53·0
				1st Ec. D.	10 48 11	
				4th Tr. I.	11 21	
				4th Sh. E.	11 46	
				1st Oc. R.	13 29	
				4th Tr. E.	15 35	
				2nd Ec. D.	17 11 29	
Sun	31			1st Sh. I.	8 5	9 49·1
				1st Tr. I.	8 27	
				1st Sh. E.	10 24	
				1st Tr. E.	10 47	

THE PLANETS FOR DECEMBER.

AT TRANSIT OVER THE MERIDIAN OF GREENWICH.

Planets.	Date.	Rt. Ascension.	Declination.	Diameter	Meridian.
		h. m. s.	° ′		h. m.
Mercury ...	1st	17 36 12	—25 37	5″·2	0 56·5
	15th	18 59 18	24 36	6″·6	1 24·3
Venus ...	1st	13 28 33	—6 57	25″·8	20 45·5
	15th	14 24	11 25	22″·2	20 46·0
Jupiter ...	1st	8 7 5	+20 34½	40″·7	15 24·9
	15th	8 2 57	20 49	42″·1	14 25·8
Uranus ...	15th	8 11 49	+20 36	4″·2	14 34·6
Neptune ...	3rd	1 22 7	+6 46½	1″·6	8 33·3
	15th	1 21 32	6 43½	0″·8	7 45·4

Mercury will be well situated for observation towards the middle of the month, setting then about 1h. 30m. after sunset; from the 22nd the interval decreases to half-an-hour at the end of the month.

Venus is a morning star, rising about 4h. before the sun throughout the month, and is well situated for observation.

Jupiter is excellently situated for observation, being visible for the greater part of the night towards the end of the month; on the 1st he rises about 4¾h. after sunset, the interval increasing to 3¾h. on the 27th.

TUTTLE'S COMET.

1871.		R. A. h. m. s.		Decl. °
Dec. 1	...	11 2 23	...	—27 44·3
2	...	11 4 55	...	29 30·9
3	...	11 7 31	...	31 15·7
4	...	11 10 8	...	32 58·7
5	...	11 12 45	...	34 39·6
6	...	11 15 26	...	36 18·2
7	...	11 18 11	...	37 54·2
8	...	11 20 58	...	—39 27·2

DYNAMETER OR DYNAMOMETER.—The little instrument for measuring the power of eye-pieces, introduced by Mr. Berthon, is entitled a *dynamometer;* I remember that in former works on astronomy an instrument was described called a *dynameter.* I should like to know which is the right appellation, or if either instrument is adapted for the same purpose.—QUERY.

[Dynamometer is the right way of spelling the word (*δυναμις*, power; and *μετρον*, a measure).—EDITOR.]

PHILOSOPHY NOT SCEPTICAL.

"There are, doubtless, philosophers and astronomers, who in their mathematical and astronomical investigations leave out of the great problem of nature the very being of God. This, indeed, in the very nature of things they are compelled to do. No power of analytical grasp, no refinement of infinitesimal arithmetic can reach the being and attributes of God. The philosopher and mathematician is compelled to begin exactly where Moses left off. 'In the beginning God created the heavens and the earth,' says Moses, and, admitting this declaration, the philosopher undertakes to discover the plan according to which this creaton was effected, and by means of which it is now maintained. The sun, the moon, the planets, the comets, the stars, exist; they roll and shine, measuring time by their mighty revolutions, and filling space by their sublime orbits. There they are as God created them, and the philosopher simply inquires, according to what laws do they move? What reciprocal influences do they exert? What are the forms and limits of their mighty orbits? What the sublime periods of their march through space? What the nature of the dynamic equilibrium which links them into groupings of surpassing grandeur?

"It is true that in all these investigations the very being of God may be forgotten. For the lawgiver we may substitute the laws. Gravitation may supersede in mathematical research the omnipotence of God. No laws of motion, simple, invariable, eternal, may stand for that attribute of Jehovah's will which changeth not, the same yesterday, to-day, and for ever. The sun himself may be shorn of his effulgence: his light, and heat, and life may shrink and fade beneath the withering breath of philosophy, and this mighty and glorious orb become a material heavy point, and all the revolving planets and their moons other material heavy points, at definite distances and with determinate weights, and thus the will of God, as manifested in His laws, and the very creations of God as exhibited in his suns, and systems, and moving worlds, become the mere hypotheses and material points in the diagram of the mathematician's slate,—and what then? Does this destroy God and his attributes? Does this blot out of the heavens the blazing sun? Does this strike from being planet, and moon, and earth teeming with life, and hope, and joy, and love, and immortality?—Never! They all remain: while the geometer grapples these wondrous orbs in their weight, dimensions, distances, and motions, with his sublime analytic machinery, and with gigantic intellectual power follows their grand career,—the problem solved, the orbit figured, the period predicted,—all, all proclaim the being of God, the unchangeableness of the laws of His physical government, and the grasp of thought with which He has endowed His own image, into whose nostrils He breathed the breath of life. It has been truly sung:

'The undevout astronomer is mad,'—

and yet, alas! we are compelled in a few instances to confess, that this madness has filled the hearts of some whose names have been written in letters of living light on the very circle of the heavens. I say a few instances, for by far the greater number of the heroes of science are to be counted among the devout; Copernicus, and Kepler, and Tycho, and Galileo, and the prince of philosophers, Newton the immortal—all looked through nature to nature's God. Kepler, in all his grand investigations, commenced his daily toil by invoking the aid of Divine wisdom, and Newton's reverence was so great, that he never uttered the name of God without reverently lifting his hand to his head, feeling the immediate presence of the divinity in His material works. And, yet, these are the greatest names which the annals of astronomy and science can boast,—their investigations were more profound, their mathematics deeper than most of those could boast, who are now compelled to acknowledge themselves humble followers of these great luminaries. We say, then, that while in minds especially framed for pure *physical* research, there is a tendency to an undue preponderance of mathematical reasoning, the abstractions of science, and the mathematics of astronomy, do not of necessity lead to scepticism."—Mitchell, *Astronomy of the Bible.*

ASTRONOMICAL REGISTER—Subscriptions received by the Editor.

To Dec. 1871.

Broughton, S.
Buckingham, J.
D'Alquen, F. M.
Darby, Rev. W.
Harris, Rev. C. S.
Jenkinson, J. H.
London Institution.
Matthews, W.
Walton, T.
Woodman, T. C.

To March, 1872.

Mills, E. B.

To April, 1872.

Lowson, D. L.

To June, 1872.

Howlett, F.
Strange, Col.

To Dec. 1872.

Gould, Rev. J.
Hollis, H. W.

To Feb. 1873.

Leigh, J.

To Dec., 1873.

Lawrence, E.

Errata. No. 107, p. 249, line 4, for LYRÆ, read LYRA.

Books received.—Mr. Williams, "Chinese Observations of Comets," Seventh Report of the Board of Visitors to the Observatory, Victoria. Symon's *Meteorological Magazine*, Denning's Astronomical Phenomena for 1872.

TO CORRESPONDENTS.

It is particularly requested that all communications be addressed to the Editor, PARNHAM HOUSE, PEMBURY ROAD, CLAPTON.

Our correspondent of Eastfield, Bolton, making enquiries for instruments, omitted to send his name.

We are obliged to postpone several interesting matters for want of space.

The Editor will be obliged if those gentlemen who have not paid their subscriptions will kindly send them by Cheque, Post-office Order, or penny postage stamps.

Our Subscribers are requested to take notice that in future *Post Office Orders* for *the Editor* are to be made payable to JOHN C. JACKSON, at Lower Clapton, London, E.

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ARABIC NAMES

OF THE

STARS AND CONSTELLATIONS:

With their Explanations.

CHIEFLY FROM THE BEDFORD CATALOGUE.

REVISED, WITH ADDITIONS, BY

GEORGE J. WALKER.

'In his enuntiandis explicandisque turpissimè hallucinati sunt viri quidam aliàs doctissimi, quorum nomina silentio prætereunda duximus; non enim delectat aliorum nævos nimis acriter perstringere, cùm de propriis obtegendis sit potius sollicitè laborandum.'

HYDE, *Comm. in Ulugh Beigh. Tab.* p. 5.

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1871.

ARABIC NAMES OF THE STARS AND CONSTELLATIONS.

THE figures and names on our celestial globes and maps, however unimportant, or even sometimes troublesome, to the practical astronomer, are of considerable interest as connected with the literature of the science. Some of them are a memorial of an ancient sphere originated by a race whose school, as Gibbon remarks, was 'a clear firmament, and a naked plain;' and others, of our vast obligation to that race, when after thousands of years of almost complete isolation from the rest of the world, they became imbued with the science of Greece and India, and materially contributed to the foundation of theoretical astronomy at the epoch of Kepler and Tycho Brahe.* 'Le flambeau des sciences,' says Laplace, 'éteint par les irruptions des barbares, ne se ralluma que chez les Arabes.' †

The imagination of the ancient Bedawís (Arab: Bedawín, desert-men) filled the heavens with imagery taken from herds and flocks, and the wild animals of their country; ‡ and this, long after, was blended with the Greek sphere which their later astronomers modified from Ptolemy.

In tracing the figures, and applying and spelling the names, many inaccuracies and corruptions on the part of the framers and transcribers of tables, and the constructors of globes and maps, have come in; the correction of which, as far as possible, is very desirable. As to the figures, it is a great merit in the large maps of the S. D. U. K. that in them 'the heavens of Ptolemy have been restored, and in no one drawing exceeded:' § only it is necessary to bear in mind Professor De Morgan's remarks, that 'Ptolemy took an outside view of figures fronting inwards; our maps are an inside view of figures fronting outwards; therefore, the left hand of a figure in our map is the right hand accord-

* Humboldt, *Cosmos*, ii. p. 224.   † *Système du Monde.*

‡ 'It is worthy of remark,' says Hyde, 'that in all the world there is no language extant in which there are so many names of stars as in the Arabic.'

§ *Companion to the Maps*, by Prof. De Morgan, p. 59.

ing to Ptolemy, and *vice versâ*:' and that 'to obtain a representation of the sphere of Ptolemy in every respect,' the maps should be 'looked at through the paper.' *

But even in these excellent maps there is room for improvement. They are wrong sometimes in the application, and often in the spelling, of the Arabic names. The object of this paper is to place within the reach of all who use maps of the stars, explanations of these names; and such a list, easy of reference, would probably be welcome, even if the admirable work from which it is mainly compiled were still generally accessible. As it is, there is no work that I know of to which the large and increasing number of amateur astronomers can refer for information of this kind, gathered by the extensive reading of Admiral Smyth from so many sources, and sifted by the excellent sense and discriminating criticism which characterise all that he wrote.

But in preparing this little companion to our celestial globes and star-maps, I have not felt bound to swear by the words even of such a master. Though limited as to range of authorities, I have carefully examined by them all the names; and besides minor improvements in their English orthography, I have occasionally ventured on more important corrections, as well as contributed some additional matter. The materials at my command were:—

1. *Ulugh Beigh's Catalogue*, with *Hyde's Commentary*, Oxford, 1665.† 2. *Arabic Lexicons*. 3. A Persian MS. from the Arabic of *Berjendi*, which I brought from India many years ago, and which is referred to as *Brj*.

The constellations, including those which did not come within the scope of the Bedford Catalogue, follow the order of Ptolemy and Ulugh Beigh. The Greek names are given from Aratus (B.C. 260), our most ancient authority for most of them. Those who desire an approximation to Arabic pronunciation should remember that the *l* of the article *al*, before the so-called 'solar letters,' represented by *t*, *d*, *dh*, *th*, *n*, *z*, *s*, *sh*, *r*, and *j*, loses its sound, and the following letter is doubled. Some names, such as Aldebaran, Altair, &c., are become so naturalised with us that it is perhaps best to retain the ordinary, though erroneous, pronunciation: but there is no reason why we should not say, for example, *ath-thurayya* (spelled al-thurayya, the Pleiades); *at-*

* *Companion to the Maps*, by Prof. De Morgan, p. 63.

† The Persian title is, *Tables of the Places of the Fixed Stars, in Longitude and Latitude, observed by Ulugh Beigh, son of Shah-rokh, son of Tímúr.* Ulugh Beigh signifies, the great prince. He was grandson of Tímúr Lang, or Timur the Lame (Tamerlane). He was born in 1393; he constructed an observatory at Samarkand; and was put to death by order of his eldest son in 1449. See Smyth's *Cycle*, vol. i. p. 32.

tannín (spelled al-tannín, the Dragon). An apostrophe preceding or following a vowel supplies the place of a guttural letter for which we have no equivalent; as: 'Adhrá, virgin; *S'ad-as-su'úd* (spelled s'ad-al-su'úd, the luckiest of the lucky, or the fortune of the fortunes). Other orthographical marks have been omitted, as not required for the general purpose of this paper.

With regard to the relative antiquity of the forms and designations in the Arabian heavens, it may be observed that the native symbolism, although of remote origin, need not be *absolutely* so ancient as some at least of that which was incorporated in more recent times from the Greeks. The descendants of Joktan, Ishmael, and Keturah most probably possessed at first the primeval system of constellations which it has been attempted briefly to indicate elsewhere;* and this may not have been ever quite superseded by, however it may have been confounded with, that which was derived from the fancy, and perhaps varied with the caprice, of the different tribes in the peninsula.

G. J. W.

* '*Origin of the Signs of the Zodiac,*' ASTRO. REGISTER, vol. v. 1867; '*Primeval Symbolism of the Great Bear and Orion,*' vol. viii. 1870.

THE NORTHERN CONSTELLATIONS.

1. Ursa Minor, Arktos (mikra), *Al Dúbb-al-asghar*. The lesser Bear. First added to the Grecian catalogues by Thales (B.C. 600), by whom it may possibly have been imported from the East. Called also Phœnike, and Kunosoura (Cynosura); the former from its being employed by the Phœnicians in navigation; the latter signifying the Dog's tail.

   Kaukab-al-shemáli, α, the Northern Star, or simply *Kaukab*, the star; called also *Jedi*, the Kid.

   Farkadan, β and γ, the two Calves: the first, *Anwar-al-farkadeïn*, the brighter of the two calves; the second, *Akhfa-al-farkadeïn*, the dimmer of the two calves.

   Yildun, δ, improperly so called. *Yilduz* is star in Turkish, and in full the name is *Yilduz shemáli*, the North Star, i.e. α Ursæ Minoris.

2. Ursa Major. Mentioned by Homer as Arktos, the She-Bear, and Hamaxa, the Waggon. The epithets 'Great' and 'Little' were added at a later period to this and the preceding constellation. Probably the same as *Ash*, and *Ayish* in Job. *Dúbb-al-akbar*, the Greater Bear. The name *Banát-n'ash*, Daughters of the Bier, was also given to it and to Ursa Minor; the former being *Al-kubra*, the greater, and the latter, *Al-sughra*, the lesser. In each the three stars which go before the bier are *Banát*, the Daughters, and the square is the bier.

   Dubhe, α, *Dúbb*, a bear. Called also *Dhuhr-dúbb-al-akbar*, the back of the Great Bear.

   Merak, β, *Maráhk-al-dúbb-al-akbar*, the loins of the Great Bear.

   Phecda, γ, *Fakhidh-al-dúbb-al-akbar*, the thigh of the Great Bear.

   Megrez, δ, *Magrez-al-dúbb-al-akbar*, the root of the Great Bear's tail.

   Alioth, ε, corrupt for *Al-jaún*, the Black Horse; called also *Al-hawar*, the intensely bright (spoken of the white and black of the eye).

   Mizar, ζ, name unknown to the Arabians; it means a girdle or apron. ζ is *Al-'anák-al-banát*, the Goat of the Daughters (i.e. mourners).

   Alcor, close to ζ, corrupt; perhaps from *Al jaún*, ε, and seems wrongly applied to this star. It is called *Suhá*, and was used as a test of vision, when fainter perhaps than now. Suhá may perhaps convey the idea of obscurity—a star easily overlooked (root, *sahá*, to forget, or neglect). Called also *Sádik*, true, perfect.

   Alkaid, η, the Governor (i.e. of the mourners). Hence the Spanish, Alcayde.

   Kafzát-al-dhibá, springs (or leaps) of the Gazelle. The six stars in the three feet, ν and ξ, λ and μ, ι and κ, were thus designated: the two in each foot one spring.

   Al-Phikra-al-úla, ν, perhaps for *Al-Kafzah al-ula*, the first spring. (The words *Fikra* and *Kafzah* are very like in Arabic letters.)

   Talitha, ι, *Al-Phikra-al-thálitha*, perhaps for *Al-Kafzah-al-thalitha*, the third spring. *Al-thániyah*, the second, was λ and μ.

   Al-Dhibá, or Zibá, the Antelopes; σ, ρ, π, δ, ο, and other stars in the eyes, ears, and nose of the Bear.

   Dhufrat al Ghizlan, the hoofs of the fawns; so called because each pair seems to mark the footprint of a fawn, near the feet of the Great Bear in Leo Minor.

SERÍR BANÁT N'ASH, Throne of the Daughters of the Bier; θ, τ, h, υ, ϕ, e and f. The space has also been termed *Al-húd*, the pond.

KABD-AL-ASAD, Liver of the Lion; one of the unformed stars of the Great Bear. 12 Canum Venaticorum.

3. DRACO. Drakōn, the Dragon. *Tinnin*. Nakhash (Job. xxvi. 13), the Serpent.

THUBAN, α, Al-th'ubán, the Dragon; synonymous with *Tinnin*.

ALWAID, β, *Al-'awáyid*, the sucking Camels (or camels feeding on a particular shrub); β, γ, μ, ν, and ξ.

ETAMIN, γ, *Rás-al-tannin*, the Dragon's head.

AL-TAÏS, δ, the Goat (Tizini).

AL-DHIBA', ι, the Hyæna; or *Al-dhikh*, Hyæna, or Wolf.

AL-DHÍBAÏN, η and ζ, the two Jackals, or Wolves.

ADHFÁR AL-DHIB, ω and f, the Jackal's claws; called by others *Al 'auhakán*, black Cattle or Crows.

GIAUZAR, λ, *Al-jaúzá*, the central; as being nearly midway between Polaris and the Pointers.

AL-RAKIS, μ, the Trotter; i.e. trotting camel.

AL-ATHÁFÍ, σ, τ, υ, the Tripod; the three stones on which the nomade Arab places his kettle.

4. CEPHEUS. Kepheus. *Al-multahab*, the Flaming; and *Al-aghnán*, the Sheep.

ALDERAMIN, α, *Al dhirá' al-yemin*, the right arm.

ALPHIRK, β, *Kawákib-al-firk*, stars of the Flock; represented by α, β, and η.

AL RAI, γ, *Al Rá'i*, the Shepherd.

KELB-AL-RÁ'I, ρ, the Shepherd's dog.

5. BOÖTES. Ploughman, or waggoner. Found in Homer. Arktophulax, Bear-watcher (Aratus). *Al-rámih*, the Lancer; *Al-'auwá*, the Shouter; *Haris-al-semá*, Keeper of Heaven; *Sannaj*, a player on the cymbals, *Brj*.

SIMÁK-AL-RÁMIH, α, the prop or leg of the Lancer. The true meaning of *Simak* is uncertain. Arcturus (Hesiod), Bear-keeper.

NEKKAR, β, an error for *Al-bakkár*, the Herdsman. β, γ, δ, and μ form the trapezium termed *Al-dhiba'*, the Hyæna.

IZAR, ϵ, a zone, or girdle.

MUPHRID, η, *Al-mufrid-al-Rámih*, the single, or solitary star of the Lancer; also called *Saák*, the shin-bone; and 'lance of 'Auwá.'

AULÁD AL DHIBA', κ, with θ, ι, and λ, the young of the Hyæna.

ALKALUROPS, μ^1, from Greek kalaurops, a shepherd's crook, or herdsman's staff.

6. CORONA BOREALIS, Stephanos, crown. Distinction between the northern and southern crowns was introduced by Ptolemy (A.D. 140). *Al-fekkah*, the dervish's cup, or platter. Also *Al Iklil al shemáli*, the northern crown, and *Fikkah*, the jaw; to the teeth in which its stars are compared. *Brj*.

ALPHECCA, α, *Al-fekkah*; also called *Naïr-al-fekkah*, the bright star of the pauper's platter. The name 'Gemma' seems of modern origin.

NUSAKAN, β, *Al-nasakán*, the two series, or rows. The name is also said to be given to two stars in the scales of Libra; and *Al-nasak* to be a name of Orion and Gemini. *Nasak* also means strung together (as pearls, or beads).

7. HERCULES. Described by Aratus as an unknown or nameless form, called Engónasin (on the knees). It is said to have received its present

name from Panyasis, B.C. 500. *Al-játhi 'alá rukbeteïhi* (the man), who kneels on both his knees. Also called *Al-rákis*, the dancer.

RAS-ALGETI, α, *Rás al-játhi*, the Kneeler's head.

KORNEFOROS, β, from the Greek Koruneforos, Club-bearer. γ Herculis is a portion of the Nasak Shami, or northern boundary wall of the Arabian garden, described by Kazwini. β is the N. f. terminus of it.

MASYM, λ, *Mi'sam*, the wrist.

MARSIC, κ, *Mirfak*, the elbow.

8. LYRA, Lura, Lyre, Khelus, Tortoise (of the shell of which the lyre was first made). *Sulhafá*, tortoise; also *Mighrafah*, a saucer, or ladle. *Brj.*

WEGA, α, from *Wáki'*, in the compound name *Al-nesr-al-wáki'*, the falling Eagle; a part being put for the whole in the Alphonsine Tables.

SHELIAK, β, a corruption from Khelus, tortoise.

SULAPHAT, γ, *Al-sulhafáh*, the Tortoise.

9. CYGNUS. Ornis, the bird, Aratus (B.C. 260), Geminus (B.C. 70?). The present name was given by Eratosthenes (B.C. 230). *Al-dajájeh*, the hen.

DENEB, α, *Dheneb-al-dajájeh*, the Hen's tail; also called *Al-ridf*, the pursuer, because it follows the four stars called *Fawaris*, the riders, δ, γ, ε, and ζ.

ALBIREO, β, of doubtful origin, or a corruption. May it be from *Al-ibrah*, the point of anything, the tip of the elbow? Here it would mean the tip or extremity of the beak. Also called *Minkár-al-dajájeh*, the hen's beak.

SADAR-AL-DAJÁJEH, γ, the Hen's breast.

RUKBAT-AL DAJÁJEH, ω^2, the Hen's knee.

AZELFAFAGE, π, (?) from *Al-dhayl-al-dajájeh*, the extremity of the Hen.

10. CASSIOPEIA, Kassiepeia, *Dhát-al-Kursa*, the Lady of the Throne. 'The Arabians made a dog of Cepheus, and its female of Cassiopeia, retaining the throne of the latter. The early Arabians considered it as a large hand, of which the bright stars constituted the finger-points, and in which was included the nebulous group in the left hand of Perseus.' Also called *Al-thuraiya*, the many. Cepheus, Cassiopeia, Perseus, Andromeda, and the Sea-monster are first mentioned by Eudoxus (B.C. 366).

SCHEDIR, α, probably a corruption of *Al-sadr*, the breast.

CAPH, β, *Kaff-al-khadib*, the stained hand (i.e. with henna); called also *Sanám-al-nákah*, the camel's hump (Tizini), the principal stars being imagined as a kneeling camel. This camel was made up of Cassiopeia, Andromeda, Perseus, and some other unformed stars. *Brj.*

RUKBA, δ, the knee.

MARFAK, μ, the elbow.

11. PERSEUS, Perseus. *Hámil rás-al-ghúl*, the bearer of the Demon's head. Also called *Cheliab*, probably from *Kulláb*, a hook; referring to the hooked weapon in the hero's hand.

MIRFAK, α, the elbow, from *Al-mirfak-al-thuraiyá*, the elbow of the many. Called also *Algenib*, i.e. *Jenb Bersháwush*, the side of Perseus.

ALGOL, β, *Al-ghúl*, the Demon. A red star, *Brj.*

MENKIB-AL-THURAIYÁ, ξ, the shoulder of the many.

MI'SAM-AL-THURAIYÁ, 33 Ḥ VI., the wrist of the many. This, with α, ξ, and ο, seem to have once been conceived as a gigantic arm, to which the 'hand' in Cassiopeia belonged; as the name *Thuraiyá* is given to them all. The connection, if any, with the Pleiades (*Thuraiyá*) does not appear.

'ÁTIK-AL-THURAIYÁ, *o* (38), the shoulder (near the neck) of the many.

12. AURIGA, Heniochus, Holding the reins, Charioteer. *Mumsik-al-'inán*, Holder of the Reins; also *Al-'innah*, the Reins.

EL-'ÁYYÚK, *α*, Aix (Capella), the Goat. Derivative of *'aák*, with the meaning of the Restrainer, or Guardian; i.e. of the Pleiades, with which it rises, and which it follows. *Brj.* A red star; *Brj.* Firuzabadi. *Á'yyúk* may possibly be derived from Aix.

MENKALINAN, *β*, *Menkib-dhi-'l'inán*, the Rein-holder's shoulders.

K'AB DHÍ-L'INÁN, *γ*, heel of the Rein-holder. This star is also *β* Tauri.

AL-JIDYÁN, *ζ* and *η*, the two Kids. The former was *Dhát-al-'inán*, possessor (feminine) of the reins. Eriphoi (Aratus), the Kids. Said to have been first named by Cleostratus of Tenedos, about B.C. 500.

13. OPHIUCHUS, Ophiuchos, the Serpent-holder. *Al-hawwá*, the Serpent-charmer.

RASALAGUE, *α*, *Rás-al-hawwá*, the Serpent-charmer's head, once called *Al-ra'yi*, from *Al-rá'ai*, the shepherd.

KELB-AL-RAI, *β*, *Kalb-al-rá'ai*, the Shepherd's heart.

YED PRIOR, *δ*, the preceding hand.

YED POSTERIOR, *ε*, the after hand. *δ* was one of the stations in the *Nasak-yemeni*, or southern boundary of the Arabian garden (see Serpens).

MARFIK, *λ*, the elbow.

SÁBIK, *η*, preceding. The S. f. terminus of the *Nasak-yemeni*, above mentioned.

14. SERPENS, Ophis, the Snake. *Huweyyah*, or *Hayyah*, the snake. 'Kazwini states that *β* and *γ* Serpentis, with the stars of the same rank and letters on the arm of Hercules, were the *Nasak shámi*, while *δ*, *α*, and *ε* Serpentis, with *δ*, *ε*, *ζ* and *η* Ophiuchi, were the *Nasak yemeni*; and the north and south lines thus formed were considered as the boundaries of a vast pasturage or garden.'

UNUKALHAY, *α*, *'Unk-al-hayyah*, the Serpent's neck.

ALYAH, *θ*[1], a broad sheep's tail. Name unknown to the Arabian astronomers.

15. SAGITTA, Oistos, the Arrow. *Al-sahm*, the arrow; called also *Nabl*, arrow, *Brj.*

16. AQUILA, Aetos, the Eagle. *Al-'Okáb*, the eagle; and *Al-nesr-al-táïr*, the flying eagle. Having its wings expanded; in contrast with the closed wings of the 'falling eagle' in Lyra, *Brj.* Hadrian assigned a star in Aquila to his favourite Antinous. As a separate constellation Antinous was first introduced by Tycho Brahe.

ALTAIR, *α*, *Al-táïr*, the flying.

TARAZED, *γ*, *Sháhin tárá-zed* (Persian), the star-striking or soaring falcon.

DHENEB AL 'OKÁB, *ζ*, the Eagle's tail.

17. DELPHINUS, Delphis, the Dolphin, *α*, *β*, *γ*, *δ*, called *Al-'akúd*, the necklace. By the vulgar *Al-salib*, the cross; and the bright star in the tail *'Amúd al-salib*, the stem of the cross. *'Aud al-salib*, the wood, or staff of the cross, *Brj.*

SVALOCIN, *α* } 'The letters of these strange words, reversed, form
ROTANEV, *β* } Nicolaus Venator, a Latin version of the name of Niccolo Cacciatore, assistant at the Palermo Observatory, in the catalogue

emanating from which these stars are so denominated' (Webb). (Should therefore not appear in future maps.)

DHENEB-AL-DULFÍN, ε, the Dolphin's tail.

18. EQUULEUS, Hippou protomé, the fore-quarters of a horse. Seems to have been introduced by Hipparchus (B.C. 140). *Kit'at-al-faras*, a portion of the horse. Also called *Al faras al-thâni*, the second horse.

KITALPHA, α, a corruption of *Kit'at-al-faras*.

19. PEGASUS, Hippos, the Horse. The name Pegasus was employed as early as Eratosthenes. The figure was supposed to represent the fore quarters only. *Al faras al-'adham*, the larger horse; and *Al faras al thâni*, the second horse. The rectangle made up of α, β, γ, and α Andromedæ, was called *Al-delw*, the water-bucket.

MATN-AL-FARAS } α, the horse's withers. *Markab*, a horse (or any
MARKAB } conveyance).

SCHEAT, β, probably a corruption of *Sâ'id*, an Arm, or forearm. Or possibly for *S'ad*, fortunate; as being with η, *S'ad matar*. Also called *Menkib-al-faras*, the horse's shoulder. α and β were also called *Fargh al-delwi-l-mukaddem*, the hither lip of the bucket. γ Pegasi, and α Andromedæ, *Fargh al-delwi-l-muachchir*, the hindmost lip, &c.

ALGENIB, γ, *Jenâh-al-faras*, the horse's wing.

ENIF, ε, the nose. Also called *Fom*, or *Fom-al-faras*, the horse's mouth.

HOMAM, ζ (and ξ?), *S'ad al-homâm*, the hero's happy star. *S'ad tamâm*, perfect fortune, *Brj.*; called *S'ad-al-nu'âm*, the ostrich's lucky star, by Tizini. Included in the group known as *Su'ûdu-l-nujûm*, the fortunate stars; 'so named because they appear to the Bedouin Arabs at the dawn of day, on the approach of spring.'

SAD MATOR, η, *S'ad matar*, the happy star (or fortune) of rain.

SAD BARI, μ, *S'ad bâri'*, the fortune of the excelling one (i.e. in virtue or science).

AL-KEREB, τ and υ, 'the joining of the two cross bars of wood placed diagonally over the well, to which the bucket-rope is fastened,' or the rope fastened to the handle of the bucket.

SAD-AL-BOHAIM, θ (and ν?), *S'ad al bahâim*, the fortune or happy star of the animals.

20. ANDROMEDA, Andromedé, *Al marat al muselselah*, the woman in bonds. The Arabians represented her as a sea-calf.

ALPHERAT, or } α, from *Sirrat-al-faras*, the Horse's navel; it having
SIRRAH } formerly been quartered on Pegasus. Called also *Râs-al-marat-al-muselselah*, the head of the woman in bonds.

JENB-AL-MUSELSELAH, β, the side of the chained woman. Called also *Batn-al-hût*, the fish's belly; and Mirach, from *Marâkk*, parts of the belly; or corrupt from *Mizâr*, apron or mantle.

ALMAK, γ, *Al-'anâk-al-ard*, the badger. Called also *Rijl-al-muselselah*, the foot of the chained woman.

21. TRIANGULUM, Deltōton, Triangle. *Mothallath*, triangle.

RÂS AL MOTHALLATH, α, the head of the Triangle.

THE SIGNS OF THE ZODIAC.

1. ARIES, *Krios*, the Ram. *Hamal*, a sheep.
HAMAL, α, a sheep; also called *Al-nátih*, the butt-er.
SHERATÁN, or SHERATAÏN } γ and β, the two signs.
MESARTIM, γ, corruption of *Al-Sharataïn*.
BOTEIN, ϵ, with δ and ρ^2, *Al-botaïn*, the little belly; in contrast with β Andromedæ (*batn-al-hút*), *Brj*.
2. TAURUS, Tauros, the Bull. *Al-thaur*, the bull. The Hyades (Rainy Stars), and Pleiades (Sailing Stars), mentioned by Homer and Hesiod. The latter called Kimah, in Job—a heap, a cluster.
ALDEBARAN, α, *Al-debarán*, the two hindmost, or following; probably originally designated α and γ. Ulugh Beigh gives the name to all the Hyades (5 stars). The name subsequently was applied to α in particular. Called 'the hindmost,' because he drives the Pleiades. Popularly known as *'aïn-al-thaur*, the Bull's eye. Also called *Táliyu-l-nejm*, following the stars, or Pleiades.
AL-THURAYYA, the Pleiades, the many, or abundance; because the rains which fell at their rising promised plentifulness. Diminutive form from *Tharwá*, abounding, on account of the smallness of the stars, *Brj*. Called also *Al-najm*, the Star. Aratus regards them as a distinct constellation.
NATH, β, *Al-nátih*, the butting; and as it is also in the Waggoner's left ankle, it was called *K'ab-dhi-l-'inán*, the heel of the Rein-holder (γ Aurigæ).
JAUZA, η, the central one. Also, *Wasat-al-thurayya*, the centre of the many; and *Neyyir*, the bright one.
AL-KELBEÏN, χ, with υ, the two Dogs.
3. GEMINI, Didumoi, the Twins. *Jauzá*, the central, because the passage of this sign is through the midst of the heavens. Also *Tawámán*, Twins.
RÁS-AL-TAWUM AL MOKADDEM, α, the head of the foremost twin.
RÁS-AL-TAWUM AL MUAKHKHAR, β, the head of the hindmost twin. Also *Rás-al-geuze* (jauzá), the head of the central one.
WASAT, δ, *Al-wasat*, the middle.
ALHENA, γ, *Al-hen'ah*, a brand (or curved mark) in a horse's neck, by which ξ is also called. γ is also *Al-meïsán*, the proud marcher, and ξ, *Al-zerr*, the button. Tízíní makes the Alhena include also η, μ, and υ.
MEBSUTA, ϵ, from *Al-dhirá' al mebsútah*, the outstretched arm, or paw (of the great lion alluded to by Kazwini, see *Cycle*, ii. p. 180).
MEKBUDA, ζ, *Mut-a-Kabbidah*, a star that passes through the zenith.
TEJAT, post, μ } (?) *Tahyát*, salutations, benedictions. Called also
TEJAT, prior, η } *Al-hen'ah*, a mark burnt on a camel's neck.
PROPUS, ι, Propous, Gr. the forefoot.
4. CANCER, Karkinos, the Crab. *Al-Saratán*, the crab.
AL HIMÁRAÏN, γ and δ, the two Asses. Onoi, the asses.
PRÆSEPE, Phatne, a Manger, *Al-ma'laf*, a stall or manger. Called also *Al-nathrah*, the fissure between the Lion's whiskers.
5. LEO, Leon, *Al Asad*, the Lion.
KALB-AL-ASAD, α, the Lion's heart; also *Meliki*, kingly; a red star, *Brj*.

Denebola, β, *Dhanab-al-asad*, the Lion's tail. Also called Serpha, from *Al-sarfah*, the changer (of the weather: from cold to hot at its rising; or, according to *Brj.*, from hot to cold at its rising; and from cold to hot at its setting). Called also Daphira, from *Al-dafirah*, the tuft of hair at the tail's extremity.

Algieba, γ, *Al-jabhah*, the forehead.

Zosma, δ, Gr. a tunic or girdle. With θ it is named *Al-zubrah*, the mane or hair on the Lion's back; also *Dhuhr-al-asad*, the Lion's back.

Rás-al-asad-al-janúbí, ε, the Lion's head, the southern.

Rasalas, μ, *Rás-al-asad al shemáli*, the Lion's head, the northern.

Minkhir-al-asad, λ, the Lion's nostril.

Al-helba, Coma Berenices (formed by Conon B.C. 250). *Halbá* (feminine), hairy. *Al-dafirah*, the braided lock (Ulugh Beigh), an extra of Leo.

6. Virgo, Parthenos, *'Adhrá*, the Virgin; or, *'Adhrá nedhifah*, the pure Virgin. Also *Sumbul*, ear of corn.

Al-Sumbuleh, α, Stakhus, ear of corn (Spica). Also *al-Simák-al-'azal*, the unarmed *Simák*; or, the support of the unarmed one. 'The true meaning of Simák is uncertain, but it appears to have been a leg of an enormous asterism of the ancient Arabs, called the Lion, without any reference to that of the zodiac.' (Comp. Arcturus.)

Min-al-'auwá, β, belonging to the barker.

Záwiyat-al-'auwá, γ, the corner of the barker.

Mukdim-al-kitáf, ε, Protrugeter, the forerunner of the vintage (Vindemiatrix).

Al-ghafr, φ, ι, κ, the covering: because dim, as if covered; or, because at their rising the trees have lost their verdure; as it were covered to the sight.

7. Libra, *Khelai*, the claws. *Mizán*, and *Zubánah*, balance.

Al-kiffah-al-janúbíyah, α^2, the southern scale.

Al-kiffah-al-shemáliyah, β, the northern scale.

Zuban-al-kravi, 20, for *Zubán-al-'akrab*, the claw of the Scorpion.

8. Scorpio, Scorpios, *Akrab*, Scorpion.

Kalb-al-'akrab, α, the Scorpion's heart. Antares, i.e. rivalling Mars (Ares) in colour. A name first found in Ptolemy.

Acrab, β, also *Iklil-al-jabhah*, the crown of the brow.

Al Shaulah, λ, the sting.

Al-niyát, σ and τ, the præcordia or outworks of the heart.

Lesath, υ, *las'ah*, stinging; a name not used by the Arabs.

Jabhat-al-akrab, ω^1 and ω^2, the forehead of the Scorpion.

9. Sagittarius, Toxeutes, Archer, and Toxon, Bow. *Kaus*, the Bow; and *Al-rámi*, the Archer.

Rucba al Rami, α, the knee of the Archer.

Min al na'áïm al Wáridah, γ, belonging to the camels (or sheep) going to water. Four bright stars. The Milky Way being considered as a stream of water. *Brj.*

Min al na'áïm al Sádirah, σ, belonging to the camels returning from water. Four bright stars. Also, *Nushaba*, for *Zujj-al-nushábah*, or *Nasl*, the point of the arrow.

10. Capricorn. Aigokerōs, goat-horned. *Al jedi*, the Goat or Kid.

Dabih major, α, *Sa'd-al-dhábih*, the lucky star of the Slaughterer.

Dabih minor, β, the same.

Sa'd al Náshirah, γ and δ, the fortunate star bringing good tidings; or, the fortune of the (earth) verdant (in spring, or the end of summer).

11. Aquarius. Hudrokhoos, the Water-pourer. The stream flowing from the Water-man is a separate constellation in Aratus, called Hudor, the water. *Dalw*, bucket, urn; and *Sákib-al-má*, the water-pourer.

Sadalmelik, α, *Sa'd-al-melik*, the king's lucky star; or, *Sa'd-al-mulk*, the lucky star of the kingdom.

Sadalsuud, β, *Sa'd-al-su'úd*, the luckiest of the lucky. Because at its rising the weather from cold becomes mild. *Brj*.

Sa'd-al-Aula', ε, the fortunate swallower; because one of the two stars seems to swallow, or absorb the light of the other.

Sadachbia, γ, *Sa'd-al-akhbiyah*, the lucky star of hidden things, or hiding-places; because when it appears, the earth-worms creep out of their holes; or, the lucky star of the tents. Called also, Kaf-al-Djenúla, perhaps from *Kaff-al-dhanub*, or *Kaff-al-dalw*, meaning the hand of the bucket; i.e. the hand which holds the bucket.

Skat, δ, may be from *Sáki*, a water-carrier; or *Askiyat*, water-skins; or *Sákiyat*, or *Sa'id*, a river, stream.

The *Su'úd-al-nujúm*, or fortunate stars, are 10: 4 in Pegasus, 2 in Capricorn, and 4 in Aquarius.

12. Pisces, *Ichthues*, *Samaka*, fish; or *Al-semakataïn*, the two fishes. Also *Hút*, the fish.

Okda, α, *'Okdat al-Khaïtaïn*, knot of the two threads; named by Aratus Sundesmos hupouraios, the tail-band.

THE SOUTHERN CONSTELLATIONS.

1. Cetus, Kētos, a huge fish. *Kaïtos* from the Gr. α, δ, λ, μ, and ξ, called *Kaff-al-jidhmá*, the maimed hand. η, θ, τ, ζ, and υ, *Al-na'ámát*, the ostriches; and ϕ, ^{1}, ^{2}, ^{3}, and ^{4}, *Al-nidhám*, the necklace.

   Menkab, α, corrupted from *Al-minkhir*, the nose, or snout; a name which the Arabians applied to λ.

   Dheneb Kaïtos Shemálí, ι, the northern branch of the Whale's tail.

   Dheneb Kaïtos Janúbí, β, south branch of the Whale's tail. Also called *Diphda*, from *Difda'-al-thàni*, the second frog; the first being *Difda'-al-auwal*, α, Piscis Australis.

   Batn-Kaïtos, ζ, the belly of Cetus.

   Kaff-al-jidhmá, γ, the maimed hand (see above).

2. Orion, mentioned by Homer and Hesiod, the K'sil of Job—a strong or mighty one. *Jabbár*, a giant. Also called *Jauza*, the central one; because the equator passes through the middle of the constellation, which is thus midway between the poles of the heavens.

   Betelgeuze, α, *Ibt-al-jauzá*, the shoulder of the Jauza. Also *Mankib-al-jauzá*, meaning the same; and *Al-mirzam*, the roarer.

   Rigel, β, *Rijl-al-jauza-al-yusrá*, the right leg of the Jauza. Also *Rá'i-al-jauzá*, shepherd of the Jauza; whose herds are represented by α, γ, δ, and κ.

   Al-nájid, γ, the subduer; or, *Al-mirzam-al-nájid*, the conquering lion; or, the brave roarer.

   Mintaka, δ, *Mintakat-al-jauzá*, the belt of the Jauza.

   Alnilam, ϵ, *Al-nidhám*, or *Nizám*, the string of pearls.

   Alnitak, ζ, *Al-niták*, the girdle: in conjunction with δ and ϵ, *Mintakat-al-jauzá.*

   Heka, λ, *Al-heka'h*, the white spot (on a horse's left side).

   Saiph-al-jabbar, η, *Saïf-al-jabbár*, the sword of the giant; also with ϑ and two other stars, *Al-lakat*, the golden grains, or spangles.

   Rijl-al-Yumná, κ, the right foot.

   Tabit, π^1, with π^2, π^3, π^4, π^5, π^6, and three other stars forming a curve, *Al taj wa al-dhawáib*, the diadem and the forelocks; or perhaps a corruption from *Dhuwábat*, meaning here the band hanging down from the crown held in the hero's hand.

3. Eridanus. Potamos, the river. *Nahr*, river.

   Cursa, β, with λ, ψ Eridani, and τ Orionis, *Kursa al-Jauzá*, throne of the Jauza. Also *Udhi*, the nest, a place in the sand where the ostrich lays her eggs.

   Achernar, α, *Ákher-nahr*, the latter part of the river. Also called *Dhalim*, the ostrich.

   Azha, η, for *Udhi*, or *Udhuwat*, ostrich's nest.

   Zaurak, γ^1, from *Neyyir-al-zaurak*, bright star of the boat.

   Keïd, 40, *Al-Kaïd*, eggshells.

   Beïd, o, and the stars near it, eggs; forming with the stars around, *Azha-al-na'ám*, i.e. *Udhi-l-na'ám*, the ostrich's nest.

   Zibal, ζ, and other stars, *Riyál*, young ostriches.

   Theemin, κ_7, (?) *Thámin*, the eighth (?)

4. Lepus, Lagó-os, the hare. *Al Arneb*, the Hare.

   Arneb, α, in conjunction with β, γ, and δ, named *Kursa*, from *Kursá-al-jauzá al muakhkherah*, the hinder throne of the Jauza; or, *Arsh-*

al-jauzá, throne of the Jauza. (Jauza, here and elsewhere, seems virtually a proper name of the giant.)

NIHAL, β, with α, γ, and δ, *Al nihál*, the thirst-slaking camels.

5. CANIS MAJOR, Kuōn, Seirios. *Kalb-al-akbar*, the Greater Dog. The distinction of Greater and Lesser Dog was unknown to the Greeks.

AL SHI'RÁ-AL-YEMANIYAH, α, the Sirius of Yemen, or Arabia Felix. (*Shi'rá*, possibly from the Greek Seirios.) Called also *Shi'rá-al-'abúr*, the crossing Sirius, i.e. which has crossed the Milky Way to join Canopus (see the Arabian fable in Hyde). Seirios means hot, scorching; Sirius is therefore the 'glow star.' In Egyptian, Sothis, the radiant (*female*). Sirius is mentioned by Hesiod. Homer twice alludes to Sirius without naming it: once as called 'the Dog of Orion.' In the Korán, Sur. 53, God is called *Rabb-al-Shi'rá*, the Lord of the Dog Star, which was worshipped by some of the old Arabs.

AL-MIRZAM, β, the roarer.

AL-WEZN, δ, weight, from appearing to rise with difficulty above the horizon.

ADARA, ε, Al-'adhára, the Virgins, comprising ο, η, δ, ε, and ι.

MULIPHEÏN, α and β Columbæ, properly belonging to Canis Major. *Al-muhlefeïn*, the two stars sworn by, because often mistaken for *Soheil*, or Canopus, before which they rise; called also *Hadár*, ground, and *Al-wezn*, weight.

PHURUD, ζ, supposed to be from *Al-furúd*, the single ones (as appearing distinct and bright when rising); but it is probably an error of transcription, easily made in Arabic, for *Al-kurúd*, the monkeys; i.e. from 2 to 5 of the smaller stars in Canis Major, with θ, κ, and λ Columbæ.

ALUDRA, η, *Al-'adhrá*, the Virgin; or, *Al-'adhára*, the virgins.

PHAET, α Columbæ. *Kaidh* (?) the hottest time of summer, between the risings of the Pleiades and Canopus.

6. CANIS MINOR, Prokuōn, before the Dog. *Al Kalb-al-asghar*, the lesser dog. Also, *Al Kalb-al-mutakaddim*, the antecedent dog.

Al Shi'rá-al-shámiyah, α, the Sirius of Syria.

GHOMEISA, β, *Al-gomeïsá*, the watery-eyed. Also *Al-mirzam*, the roarer; a name also given to β Canis Majoris, and γ and α in Orion. Also called by some, *Al dhirá' al mabsútah*, the outstretched arm.

7. ARGO NAVIS. Argo, *Safinah*, ship. Like Pegasus and the Bull, only half the object is represented—the portion behind the mast.

SOHEIL, α (Canopus), Kanōbos; first appears in Eratosthenes (B.C. 240), and Hipparchus (B.C. 150). Called by Eudoxus and Aratus, Pedalion, the rudder. According to Strabo, Eudoxus (B.C. 366) was accustomed to observe this star from his observatory at Cnidus. Soheil, from the root *sahil*, mild, gentle; perhaps so called on account of its supposed beneficent influences.

TUREÏS, ι, a little shield. Gr. Aspidiské.

ASMIDISKE, ξ, error for the preceding.

8. HYDRA, Hudré, the Water Snake. *Shujá'*, serpent.

ALPHARD, α, *Al-fard*, the solitary; perhaps because brighter than any near it. Also called *Unk-al-shujá'*, the Serpent's neck.

MIN-AL-'AZAL, θ, together with δ, ε, η, ξ, ω, and σ, of the unarmed. See Virgo.

'OKDAH, τ^1, τ^2, ι and Α, the knot (of the throat). (Kazwíní.)

Minchir-al-shujá', σ, the nostril of the Serpent.

9. CRATER, Kratér, the Cup. *Bátiyah*, a large cup. Also *Al-kas*, the cup. *Al-ma'laf*, the stall, or manger (Abdrrahaman Sufi).

10. CORVUS, Eidōlon Kórakos, the figure of a crow, or raven. *Ghuráb*, crow, raven. Called also *'Arsh al simák-al-'azal*, the throne of the unarmed Simak (Spica). Also, *Al-ajmál*, the camels; *Al-khibá*, the tent; and *'Ajuz-al-asad*, the Lion's rump; from an enormous constellation of which it was a part (not the lion of the zodiac).

MINKAR-AL-GHORAB, α, the raven's beak.

JENÁH-AL-GHORÁB-AL-AYMAN, γ, the right wing of the raven.

ALGHORÁB, δ, the raven. In the old Alphonsine Tables the name Algorab is applied to γ.

11. CENTAURUS, Kentauros. *Kantaurus*, the Centaur. The Centaur and Lupus together called *Al-Shamárikh*, the clusters of dates, on account of the compressed multitude of stars in that region (Abdrrahaman Sufi).

RIJL-KENTAURUS, α, foot of the Centaur; also *Wezn*, weight.

HADÁR, β, ground, α and β, were called *Muhlefeïn*, and *Muhnetheïn*, sworn by, and falsely sworn by; each being sometimes taken at its rising for Soheil (Canopus); so that persons swore it was Soheil (Abdrrahaman Sufi). See in Canis Major. 'In the time of Ptolemy (A.D. 140), the altar, the foot of the Centaur, the Southern Cross, then included in the Centaur . . . and lastly Canopus (Canobus) . . . were all visible above the horizon of Alexandria.' (Humboldt, *Cosmos*, iii. p. 116). 'The Christian anchorites in the Thebais may still have seen the Cross at an altitude of 10° in the fourth century' (ii. p. 291). 'The Southern Cross began to be invisible in 52½° north latitude 2,900 years before the Christian era. According to Galle it might previously have reached, in that latitude, an altitude of more than 10°, and when it vanished from the horizon of the countries adjoining the Baltic, the Great Pyramid of Cheops had already been standing in Egypt for five centuries' (ii. p. 293). 'The beautiful stars of the Centaur and of the Southern Cross will at some future day be visible in our northern latitudes, whilst other stars (Sirius, and the stars forming the belt of Orion) will no longer appear above the horizon' (i. p. 139).

12. LUPUS, Therion, wild beast. *Sabu'*, a savage beast, lion. Lynx (Lupus Cervarius); not named by the Greeks or Romans.

13. ARA, Thuterion, altar. *Mijmarah*, censer.

14. CORONA AUSTRALIS, not named by Aratus. Called Stephanos Notios, the southern crown, by Geminus and Ptolemy. *Iklíl-janúbi*, the southern crown. Called also *Al-Kubbah*, the dome or tent, in which was *Ráá'i-al-na'äim*, the shepherd of the cattle. (See in Sagittarius.)

15. PISCIS AUSTRALIS, Ikhthús Notios, the Southern Fish. *Al-hút-al-janúbi*, the southern fish.

FOMALHAUT, α, *Fom-al-hút al janúbi*, the mouth of the Southern Fish. Called by the Arabians *Difda' al-auwal*, the first frog (see β Ceti); and *Al-Dhalím*, the male ostrich.

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